QUARTERLY PROGRESS REPORT
DRD 875MA-003
July 2005 – September 2005

Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179

Approved:

Original signed by:

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1.0 INTRODUCTION

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's fourth quarter of the fourth option year: July 2005 through September 2005.

2.0 GENERAL MANAGEMENT

2.1 Data Requirements

The fourth quarter of the fourth option year of the S&MA Mission Services contract was successfully completed on September 25, 2005. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

2.2 Personnel Status

(b)(4)

3.0 BUSINESS MANAGEMENT

We have experienced no financial or business management problems during this period. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost under-run at the end of this period---see the September 2005 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period. (b) (4)

4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT

4.1 Safety

4.1.1 Industrial Safety (IS)

The Industrial Safety team performed 90 OSHA compliance annual facilities inspections and

provided all required reports in a timely manner. Also, IS performed 271 construction site compliance inspections to monitor adherence to OSHA and MSFC safety standards. All facility safety violations were documented in the SHEtrak database in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: (1) participated in six final safety inspections of facilities under renovation or construction; (2) reviewed 90 sets of facility design drawings for compliance with OSHA and consensus codes; (3) performed 21 annual fire drills; (4) taught one training class to supervisors on how to perform monthly workplace safety visit inspections; (5) participated in one preconstruction conference of facilities being modified or upgraded; and, (6) as a specific customer request, HEI continued to provide (b)(4) who monitored construction and maintenance operations when working on energized systems for compliance with to proper Lockout/Tagout procedures. Although MSFC budget cuts led to a reduction from 3-4 days per week to one day per week during period, 146 locations were surveyed.

In support of S&MA Technical Directive Number 0131, IS continued to provide additional administrative and technical support to the MSFC SHE Committee to include: (1) assisted with finalizing of the CY 2005 SHE Program Annual Plan; (2) entered SHE actions item in CAITS; and, (3) assisted the SHE Committee Chairperson and QD50 supported monthly SHE Committee meetings including collection and organization of pre-meeting briefing charts, serving as recorder, and preparing draft meeting minutes.

IS initiated, completed, or followed-up on numerous facility safety assessments (SA) and associated hazardous operations reviews. Examples include: (1) Burst Test of the Composite Over-Wrapped Vessels; (2) Micrometeoroid/Space Debris Light Gas Gun in building 4612; (3) Booster Separation Motor (BSM) proposed testing at Test Stand 116; (4) Reciprocating Feed System (RFS) Technology Demonstration at building 4777; and, (5) reviewed multiple hazardous operations operating procedures for test being moved to the new Propulsion Research Laboratory, building 4205 such as the 9-foot vacuum chamber being installed in Room 101.

IS continued to support the implementation of the NASA lifting standard, NASA-STD-8719.9, by providing day-to-day advice and assistance to S&MA customers. IS advised civil service and contractor managers, supervisors, and employees on requirements for lifting equipment usage in support of the MSFC SHE Program. Also, IS continued to be an active participant in the Lifting Device Equipment (LDE) SHE Subcommittee. In support of the task to administer proficiency exams to civil service and contractor operators of overhead cranes, fork lifts, small truck mounted hoists, and aerial lifts, IS administered hands-on proficiency examinations to twenty-four overhead crane and seven forklift operators in support of the MSFC Personnel Certification Program. To date in CY05, IS performed 81 proficiency exams or for this contract year, 101 proficiency exams.

As a continued significant strength, IS continued to provide dedicated, full-time safety and quality support to the MSFC Test areas. Examples of support included: (1) reviewed and approved multiple operating and test procedures for hazardous operations; (2) reviewed the Quantity–Distance (QD) requirements for the Gaseous Hydrogen/Gaseous Oxygen testing at

building 4626 and off-loading of class 1.1 explosives at the MSFC/NASA Dock; (3) reviewed the Facility Operations Procedure for the Hybrid Solid Fuel Torch at Test Cell 104; (4) participated in planning meetings for disassembly of the 24-inch SRTM IC-XL-1; (5) actively participated in daily and weekly safety meetings/safety stand downs of the MSFC East and West Test Areas, S&MA Safety and Quality team and the Engineering Directorate's Test Laboratory; (6) as an additional duty, served as the alternate safety representative for test area facilities; and, (7) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

The two person HEI safety team at Stennis Space Center (SSC) continued their outstanding support to SSC S&MA by preparing system safety analyses and presenting test readiness review analysis data to meet Propulsion Test Directorate compliance requirements at the E-Complex Test Facility. Programs and projects assessed included: IPD (Integrated Powerhead Demonstrator), External Tank Sensor Test Project, ITA (Instrumentation Test Article), HMTP (Hybrid Materials and Gas Generator), and E2/E3 Facility System Hazard Analyses. In addition, examples of the technical support function included: participating in design reviews, facility upgrade reviews, weekly telecons, technical interchanges, scheduling & sidebar meetings, delta tabletop discussions, etc. Support was briefly interrupted by Hurricane Katrina on 8/29/05 and numerous days thereafter. The Category 4 Hurricane caused damage to SSC facilities and SSC employees' homes and property leading to the decision to temporarily relocate the two HEI employees to support MSFC. On 9/19/05, these employees returned for duty at SSC.

4.1.2 System Safety Engineering (SSE)

(b)(4)

SSE wrote and delivered classes on Fault Tree Analysis, System Safety Basics and Basic Hazard Analysis to support HEI and MSFC S&MA System Safety Training modules.

QD10

SSE supported a review of Constellation S&MA documents by submitting comments, presenting the status of the Safety Requirements Document, and supporting the review of other constellation documents at JSC. SSE supported the review of the System Requirements Specification for the Crew Launch Vehicle document for Constellation and started developing an integrated Crew Exploration Launch Vehicle (CELV) fault tree. SSE reviewed the final Constellation Design for Minimum Risk matrix and presentation to be given at JSC. SSE investigated and reported on methods to assess Crew Launch Vehicle design and changes from a safety board perspective.

QD20

SSE participated in the SSME STS-121 Post Flight Analysis on 08/10/05. Information gathered for future MSFC Safety Engineering Review Panel consideration included root cause assessment of the STS-114 Main Engine 1 Recirculation Isolation Value anomaly (longitudinal vehicle oscillation due to propulsion system coupling, sometimes called "Pogo") and the resolution of

several Unsatisfactory Condition Reports (UCRs) which may warrant updates of related Hazard Report Background information.

SSE closed all verifications on the Safety Verification Tracking Log for the Reinforced Carbon-Carbon On-Orbit Crack Repair (ROCR) project and submitted the documentation to the Safety and Mission Assurance Review Team (SMART). SSE supported the ROCR Detailed Test Objective (DTO) that was performed during Extra-Vehicular Activity-1 of STS-114. The DTO was successful in repairing practice damaged specimens. SSE updated and reviewed the STS-121 Risk Assessment Executive Summary Report for ROCR and prepared slides to present to the ROCR team describing the information that will be required to complete the STS-121 Safety Package. SSE supported the STS-114 crew debrief concerning the ROCR material. The crew gave a summary on the workability of the material in space and asked questions of the ROCR team concerning the additional testing that is planned. SSE supported the testing TIM held for ROCR to solidify the development testing and verification approach.

SSE reviewed and evaluated Shuttle Integration hazard reports related to element hazard reports discussed at MSFC Safety Engineering Review Panel meetings. SSE participated in the Special Systems Integration Control Board (SICB) meeting this period. Covered items included discussion of changes to the Integrated Main Propulsion System (IMPS-03) hazard report related to the unexplained Engine Cut-Off (ECO) sensor anomaly on the External Tank, changes to integrated hazard reports related to the bellows heater, and to discuss and disposition the Integrated Debris (IDBR-01) hazard report. SSE supported fault tree development for the External Tank ECO sensor anomaly on STS-114.

SSE supported the post-launch External Tank (ET) foam loss investigation, reviewing ET Hazard Reports and CILs and attending daily S&MA meetings. SSE provided pre-launch ET Return to Flight support and supported STS-114 launch on 07/26/05.

SSE reviewed all integrated hazards to identify all Reusable Solid Rocket Motors (RSRM) causes that contain an increase in risk, and developed a chart to be presented to JSC integration. SSE reviewed all element level hazard reports to update the hazard report risk matrix summary. SSE attended RSRM offsite 8/19-23/05. SSE reviewed and disposed twenty-five change requests. SSE reviewed the ATK Thiokol Safety Plan.

SSE attended a three day Plylift Technical Interchange Meeting (TIM) for Reusable Solid Rocket Motors (RSRM) at ATK Thiokol. The team reviewed a fault tree and identified which blocks of the fault tree to focus on.

SSE has completed the MSERP action to review and verify all unique hazard causes from RSRMs do not rely on inspections at vendor level. SSE worked on an action issued by RSRM S&MA to demonstrate how RSRM unique hazard causes that requiring inspections have "closed loop tracking." SSE is compiling a summary of MSERP actions closed prior to RTF.

SSE has been writing the Marshall Procedure Requirement (MPR) and Marshall Work Instruction (MWI) that will describe the structure and function of the MSERP and its relation to other Safety and Engineering Panels. SSE supported internal and review meetings of the

MSERP, filling the positions of technical writer and the Executive Secretary. The Executive Secretary and the technical writer worked on the minutes for MSERP reviews. SSE has been working on a web site for the MSERP. SSE supporting the MSERP, followed the fault-tree closure actions of the Ice-Frost Ramp assessment team as part of the External Tank STS-114 Post-Flight Foam assessment.

SSE supported the review of MSERP documentation, schedules, & planning activities. Executive Secretary and Technical Writer, supplied by SSE, conducted weekly planning meetings with the MSERP Chair to organize the efforts of the MSERP. SSE has developed procedures and processes for how to conduct the meetings and then the process for handling information that resulted from the meetings.

SSE developed Certificate of Flight Readiness status summaries for Joint 2 and Joint 5 gas path In Flight Anomalies (IFA) for RSRM.

SSE supported the regular meetings of the Solid Rocket Boosters (SRB). SSE reviewed Engineering Change Proposal-4130 - '2005 Annual SRB Flight System Safety Hazard Reports Update.' SSE reviewed two change requests, two other engineering change proposals, and a Launch Commit Criteria (LCC) Change Notice (LCN).

SSE reviewed the following documents: CR S061990M - Update the Expendable Launch Vehicle Information Services (ELVIS) Configuration Effectivity; CR S062776 - Authority to Proceed With Implementation of PAL Ramp Removal and Non-PAL Ramp Design; CR S062776A - Request for Authority to Implement Instrumentation to Obtain ET PAL Ramp Data; CR S062565B - SSP Range Safety System (RSS) Command Frequency Change; CR S062661A - Update NSTS (National Space Transportation System) 07700 Vol. X, Book 1 to reference JSC 20793; ECP 4302 – Create New ASA (Altitude Switch Assy.) Test Requirements Document; ECP-4130 - '2005 Annual Solid Rocket Boosters Flight System Safety Hazard Reports Update.'

SSE participated in the Integration Control Board (ICB) as PSE&I S&MA representative for Jennifer Hawkins. This activity was 9/20-9/21/05.

SSE attended MSERP meetings related to the External Tank foam loss investigation. This included team meetings to discuss investigation findings with respect to MSERP, as well as attending scheduled telecons to hear the status from the investigation team at Michoud Assembly Facility (MAF). Part of this activity involves reviewing the foam loss fault tree (produced at MAF) against the existing T.02 tank hazard report and fault tree for consistency.

SSE evaluated the risk assessment section of QD21's draft SMARR charts addressing the recent Space Shuttle Main Engines (SSME) controller resistor failure, provided review comments to QD21, and then supported the subsequent STS-114 prelaunch SMARR tagup teleconference on 07/08/05.

During evaluation of Program Change Proposal (PCP) number 436, which proposed deleting an obsolete requirement from some SSME actuator critical items list (CIL) items, SSE identified five additional actuator CILs requiring that change that had been omitted from the PCP. SSE,

along with Reliability Engineering and Quality Engineering, conducted a teleconference with Rocketdyne engineering personnel to discuss the concern. SSE submitted the recommended changes for PCP 436, and notified the MSFC Change Package Engineer (CPE) that Rocketdyne was in complete agreement with the S&MA comments.

SSE completed evaluation of nine SSME changes (two of which were recommended for approval with changes, and the remaining seven for approval as written) and three Systems changes (one of which was recommended for approval with changes, and the remaining two for approval as written). SSE provided Safety support to QD21 for SSME during the first attempted launch of STS-114 on 07/13/05. When an anomaly in temperature measurements for Main Engine One was noted, SSE performed research to identify all of the hazard analysis and FMEA/CIL concerns potentially related to this anomaly, and assisted QD21 in documenting a problem summary and an assessment of the associated risk. SSE provided SSME Safety support at the Huntsville Operations Support Center (HOSC), during the night of 07/25/05 through the morning of 07/26/05, for the tanking and launch of STS-114. SSE participated in a teleconference on 08/05/05 that examined the basic features of the AHMS SSME controller upgrade and a summary of the proposed FMEA/CIL updates for it. SSE traveled to SSC with other members of the MSFC SSME S&MA team for an overview of SSME-related aspects of SSC operations, meetings with various SSC S&MA personnel, and a discussion of SSME S&MA activities, common goals, and teamwork. SSE completed its review of the proposed FMEA/CIL updates for the SSME Advanced Health Management (AHM) controller upgrade. SSE identified several errors. SSE participated in the S&MA team peer review of the document on 08/29-31/05 at the Pratt & Whitney Rocketdyne (PWR) facility in Canoga Park, CA. SSE identified several concerns. SSE reviewed new SSME Unsatisfactory Condition Reports and KSC Problem Reports to identify potential new technical issues and hazard analysis impacts. SSE has evaluated a draft copy of proposed SSME hazard report updates being made in response to action items from the recent return-to-flight (RTF) Integrated Hazard Analysis effort. Several errors were noted during the review, and specific corrections to be recommended by SSE during the team review of these items on 09/27-29/05 at the Pratt & Whitney Rocketdyne (PWR) facility in Canoga Park, CA.

QD30

SSE assisted with preparation of the Reflown Package for Microgravity Science Glovebox (MSG) items planned for ULF1.1 ascent for new items on the ULF1.1 ascent manifest, resupply items, orbital replacement units (ORU), and airborne support equipment (ASE). SSE participated in a table top review of the MSG Resupply ULF1.1 Reflown Package.

SSE conducted a survey of safety documentation to find the relevant hazard documents relating to the MSG Rack Area Smoke Detector Assembly (ASDA).

SSE researched the origin of the Oxygen sensor requirement for investigations, listed in the MSG Hardware Investigation Interface Requirements Document. The requirement could not be traced to higher level documents, but was found in the Payload Accommodations Handbook prepared by the European Space Agency.

SSE wrote the Safety Data Package for integration of the Protein Crystal Growth Monitoring by Digital Holographic Microscope (PromISS-4) investigation with the MSG. The package was submitted to the PSRP on 09/13/05. SSE provided comments to the European Space Agency (ESA) on their PromISS-4 investigation safety data package. On 09/19/05, System Safety Engineering was informed by the PSRP Executive Secretary would review the package out of board.

SSE completed slides for the TIM to be held with the PSRP on 09/27/05. The topic of the meeting is the requirement for investigations to provide oxygen sensors inside the Working Volume of the MSG when using the nitrogen system. The requirement is included in the MSG investigation interface requirements document, but does not flow from higher level NASA or ESA requirements documents.

SSE reviewed and updated the ground safety assessment of the use of Ferrite beads during ground testing of Node 2 at KSC. SSE reviewed information submitted for action item closure. SSE reviewed and rewrote hazard report controls and verifications. SSE supported the Node 2 Closeout and Process review with representatives from KSC and JSC. SSE continues to review the data that has been submitted on the Node 2 to close Hazard Report Control Safety Verifications. The document numbers that were referenced previously was determined to be valid document numbers and will be used to close verifications. SSE reviewed data from Boeing concerning the Common Berthing Mechanisms (CBM) and hatches, and used this to close three additional safety verifications. SSE supported the Change Control Board; no changes with safety impacts. SSE reviewed 38 changes that affect the Node 2 or Node 3. None of these changes had any safety impact to the Nodes.

SSE reviewed and provided minor comments for the ECLSS ground safety data package and associated hazard reports.

SSE supported the Safety Review Panel special topics to discuss the generation of the Noncompliance Report on the lack of proper testing for Government Furnished Equipment (GFE).

SSE reviewed the Node 3 Phase II hazard reports and compiled a matrix that contains the testing and inspections used the verify hazard controls. Node 3 is in the process of de-scoping the testing of the module at KSC and this matrix will be used to identify those tests and inspections that are required to close hazard report verifications.

SSE has been evaluating how to handle the Materials Science Research Rack (MSRR-1) Thermal & Environmental Control System (TECS) Shelf in the event of an anomaly.

SSE supported the Materials Science Research Rack MSRR-1 Payload Laptop Computer (MPLC) SRR and subsequent pre- Review Item Discrepancy (pre-RID) screening. SSE identified several areas that will require update of the safety data package for phase III.

SSE arranged a meeting of the MSRR-1 team with the KSC GSRP Chairman, Paul Kirkpatrick, and Tom Palo to discuss ground safety for the project at KSC.

SSE supported MSRR-1 Requirements & Verification Compliance (RVC) document closure actions.

SSE supported discussions with the MSRR-11 team and JSC Payload Safety Review Panel (PSRP) representatives concerning testing of quick disconnects (QD) on the Vacuum Access System (VAS) & the Thermal and Environmental Control Shelf (TECS). Previous removal and disassembly of these QDs has resulted in galling to the point of rendering the QDs unusable. SSE is working with the team to determine the best course of action to satisfy the requirements for qualifying these QDs.

SSE continues to work on developing the MSRR-1 phase III flight and ground safety data packages and is working on the delta Phase II Ground Safety data package for the Materials Science Research Rack (MSRR-1). The goal is to have a package generated for team review by 10/14/05.

SSE reviewed the draft phase III Safety Data Package (SDP) for Lab On A Chip Application Development (LOCAD). SSE supported discussions with the Payload Safety Review Panel (PSRP) BioSafety representative to obtain the Biohazard Level (BHL) rating for the various sampling sites proposed by the project. SSE supported closure for actions assigned at the phase 0/I/II safety review. SSE reviewed and commented on the Phase III Ground Safety Data Package (GSDP). SSE supported a dry run presentation of charts prepared for the flight review.

SSE attended the Phase III Flight Safety Review for LOCAD on 9/14/05. All three hazard reports were approved and signed, and action items from phase II were closed. No action items were generated for phase III. SSE supported efforts to close safety-related verification items.

SSE supported the normal Multi-Purpose Logistics Module (MPLM) team meetings. SSE provided a copy of the latest Limited Life Items List for Flight ULF-1.1 to the MPLM Project. SSE also provided a copy of the Flight LF-1 MPLM/Orbiter Reflight Assessment to ALTEC. SSE also provided support for investigating the MPLM hatch opening anomaly during the Flight LF-1 mission.

SSE reviewed the monthly MPLM presentation to the OB office and provided comments back to Lockheed Martin. SSE also supported this meeting by telecon. SSE provided information to the Payload Safety Review Panel on the three Items For Investigation (IFI) that were opened during the LF-1 mission.

SSE put together safety verification closure packages based on the as-run installation and test procedure for the MPLM Programmable Thermostat System (PTS).

SSE supported the normal Urine Processor Assembly (UPA) and WRS team meetings. SSE changed the first eight of nine hazard reports and released a draft copy to the WRS Project for review. SSE also added a Limited Life Items list and provided the project with a list of the data needed to finish the report. SSE reviewed two UPA verification packages and provided

comments back to the project. SSE also reviewed and provided comments to two Water Processor Assembly (WPA) test procedures.

SSE updated the Oxygen Ground Safety (OGS) hazard reports and the Hazard Safety Assessment, the On-Orbit Operations section, and the OGS System Description. SSE made additional updates to the first three hazard reports. SSE also put together a Safety Verification Tracking Log (SVTL) for the Oxygen Generator Assembly (OGA) for tracking Hamilton's safety verifications. SSE incorporated a new hazard report submitted by Hamilton (OGA-27) into the OGS hazard reports as OGS-013. SSE incorporated Revisions G and H of the OGA hazard reports into the OGS hazard reports. SSE also updated OGA and OGS SVTL with safety verification closures.

SSE reviewed the OGS Safety Data Package (SDP) and released it to NASA S&MA for review and approval. The SDP was expected to be sent to the ISS SRP by 09/30/05. The tentative date for the SRP review is 11/4-10/05.

SSE has incorporated the OGS Maximum Design Pressure analysis and the Fracture Control Plan into the appendices of the Safety Data Package.

SSE supported the Station Problem Resolution Team (SPRT) meeting this period for the Biological Research Project (BRP). Test, Teardown, and Evaluation (TT&E) reports where reviewed and approved for Manufacturing Action Request (MAR) 105 and 107 during the SPRT.

SSE completed a Draft narrative description of the following systems for the ECLSS Ground Support Equipment (GSE) Ground Safety Data Package (GSDP): Internal Thermal Control System (ITCS) GSE Accumulator Gaseous Nitrogen (GN2) Servicer, OGS Rack Avionics Air Assembly (AAA) GSE, OGS Rack GN2 Supply Servicer GSE, OGS Rack Wastewater Collection GSE, OGS Vacuum Pumping System GSE, and the OGS Rack Potable Feedwater Supply GSE.

SSE updated the preliminary hazards analysis and developed hazard reports for the ECLSS Test Support Equipment (TSE). SSE completed draft pressure component device listings for the OGS Rack Potable Feedwater Supply GSE and the OGS Rack Vacuum Pumping System GSE. Factors of safety based on rated pressure were calculated for each device and included in the tables. SSE prepared a table listing the requirements for typical ECLSS GSE pressure components. SSE completed Draft pressure component device listings for the ITCS GSE Accumulator GN2 Servicer, the OGS Rack GN2 Supply Servicer GSE, and the OGS Rack Wastewater Collection GSE. Factors of safety based on rated pressure were calculated for each device and included in the tables.

SSE updated the Ground Safety Data Package to QD30 for review by the ECLSS project and updated the hazards analysis on the ECLSS GSE.

SSE participated in a project review meeting for the ECLSS GSDP. SSE met independently with MSFC Quality Assurance (QA) to determine the validity of the hazard controls and verifications that reference MSFC QA actions.

4.2 Reliability

4.2.1 Reliability & Maintainability Engineering (R&ME)

QD10

During the 4th Quarter of Fiscal Year 2005 Reliability and Maintainability Engineering (R&ME) continued to support the Constellation Program through its involvement in meetings and telecons regarding reviews, comments and revisions in order to provide status, discuss recent issues, and possible future changes/modification on the Constellation Program's FMEA/CIL Methodology requirements document with its QD10 constituents.

R&ME created status and issue charts for a scheduled face-to-face meeting this quarter at JSC in order to promote additional resolution of the primary/ most contentious issues of the Constellation FMEA/CIL methodology requirements documentation. As a result of this task R&ME revised the document and resubmitted it through the configuration management process.

R&ME reviewed the Constellation FMEA/CIL methodology requirements documentation versus the comments received post base-line. R&ME also reviewed the Top Level S&MA Plan and Hazards Requirements documents in order to weed out any conflicts with base-lined FMEA requirements document. This effort was conducted in order to prepare for the S&MA Integrated Development Team TIM, originally scheduled for the week of 07/18/05 but was postponed until the week of 07/25/05.

R&ME participated in NASA's agency wide Face-to-Face meeting in Houston, TX. The discussions involved all aspects of the Constellation program's top-level S&MA requirements documents.

R&ME provided an updated draft of the Constellation FMEA/CIL methodology document along with updating comments/issues matrix which included new issues from the JSC meeting.

R&ME continued to take part in meeting/discussions involving Classification of Criticalities for the Constellation Program FMEA Requirements documentation.

R&ME participated in several discussions via e-mail and teleconferences concerning changes to the updated draft of the Constellation FMEA/CIL methodology document (Revision A). The last discussion was held on 8/26/05 and wrapped-up all open issues pending completion on the Constellation FMEA/CIL Requirements document. The open issues wrap-up effort was spearheaded from a MSFC/R&ME perspective in order to get the document through the CM system/process.

R&ME provided another draft update to Revision A of the FMEA/CIL Methodology document and also provided a response to comments and a summary of options for a different approach to analyses of electrical harness failures. A response from KSC on GSE issues is required before the document can be finalized.

R&ME provided comments on the latest version of the Constellation Program's FMEA/CIL Requirements Document and recreated Figure 3.3.1 in order to be in-line with the latest accepted Criticality Definitions and CIL criteria flowchart.

QD20

RCC R&ME

R&ME continued to provide dedicated support this quarter to QD20's Return-To-Flight (RTF) activities by thoroughly working with the Reinforced Carbon-Carbon (RCC) Crack Repair Material (CRM) project. The RCC repair program had conducted its pre-flight review and was ready for launch and use in a DTO demonstration for STS-114 until encountering the first launch delay. RCC R&ME is currently awaiting feedback from the DTO on STS-114 but is proceeding with preparations for a second, more extensive, DTO during STS-121. RCC R&ME is currently preparing for an upcoming Technical Interchange Meeting (TIM) regarding the Development and V&V test plans.

ET R&ME

R&ME provided S&MA support for the launch of STS-114 in the PAC Room in Building 4471. As a result of the scrub of STS-114, caused by violation of launch commit criteria (LCC), R&ME was assigned to an investigative team for EMI anomalies following problems in the ECO sensing circuitry. This resulted in the ET Engine Cutoff (ECO) Sensor Failure Common Cause Analysis. A concern was raised by NASA that failure could be due to a factor that could affect more than one sensor, or even a sensor and other critical components. A team consisting of several Safety and Mission Assurance (S&MA) disciplines was called on to produce a fault tree addressing common cause factors. The analysis was duplicated by another team at KSC, and the results were collated to form a final tree and report. This tree was assigned to a team for closure along with the conventional fault tree.

SSME R&ME

R&ME was involved in the support of updating the SSME FMEA/CIL for the AHMS Phase I upgrade this quarter. The Phase 1 AHMS upgrade is scheduled to fly on STS-117 and consists of modifications to the existing SSME controller which includes: an upgrade to the SSME controller to reduce the probability of catastrophic failures due to SSME high pressure fuel or oxidizer turbo-pump failures by eliminating the weakness of the current Flight Accelerometer Safety Cutoff System (FASCOS) of erroneous engine shutdown due to sensor, harness or controller interface/functional failures; adding vibration redline monitoring for the high pressure turbo-pumps; doubling memory capacity and utilizing radiation tolerant memory; adding external communication interface for Phase 2 Health Management Computer (HMC) and eliminating existing memory retention batteries and replacing with non-volatile memory.

R&ME reviewed a preliminary copy of ECP 1386R2 this quarter that documents the results of the Failure Mode and Effects Analysis (FMEA) and Critical Items List (CIL) of the Space Shuttle Main Engine (SSME) for the Block II Space Shuttle Main Engine Controller (SSMEC) Advanced Health Management (AHM) upgrade by the Boeing Company, Rocketdyne. The

Advanced Health Management System (AHMS) Phase 1 Reliability and Maintainability (R&ME) completed a 3 day review of proposed FMEA/CIL changes for the Block II Space Shuttle Main Engine Controller (SSMEC) Advanced Health Management (AHMS Phase I) upgrade by Pratt &Whitney/ Rocketdyne. Safety & Reliability Engineering had the overall responsibility of ensuring that the updated FMEA/CIL reports were technically correct and complete. AHMS Phase 1 replaces FASCOS (analog redline) with a Synchronous Redline (digital redline). The Synchronous Vibration Redline provides enhanced capability to detect and mitigate potential catastrophic high pressure turbo pump failures. The total numbers of SSME FMEA/CIL reports affected by the AHMS Phase I upgrade were 499. Of the 499 reports, a total of 20 reports were deleted.

R&ME attended a test firing of the A-2 Main Engine 0525 this period. The Test's (#902-859) for Engine 0525 primary objectives were to: demonstrate a new FPB liner redesign; certification of the Fuel System Kevlar Insulation System (Rigid Fuel Bleed Duct, Articulating Fuel Bleed Duct, High Pressure Fuel Duct); Certification of the Quarter-Shield design thermo-couples; Certification of the 2nd Cutback Inducer blade design certification unit; and Certification of the AHMS Phase I and Green Run HPOTP 8124.

R&ME was involved in this quarter's discussions concerning the technical rational behind a project ground-rule that classified the risk for failure modes resulting in a safe SSME shutdown, hydraulic/pneumatic lockup, or performance degradation as a Crit. 1R.

SRB R&ME

R&ME was a member of this quarter's Solid Rocket Booster (SRB) Anomaly Resolution Team (ART) to determine the root cause(s) and corrective action(s) on the upgraded harness assembly of the Integrated Electronics Assembly (IEA) this period. After a qualification failure of the harness in 15 mission vibration testing of the Z axis, R&ME pushed for fault tree development on the harness as well as for the Power Bus Isolation Supply (PBIS) cards that had experienced failures during initial vibration testing. The PBIS cards are not being qualified but are integral to the completion of the harness qualification testing. However, fault trees were developed for the harness and PBIS card failures. R&ME's responsibilities for fault tree closure were operator error/training and procedural deviation. The fault tree blocks were deemed improbable and closed after a thorough review of training documentation and procedural steps in conjunction with stamp warranty. The harness failure fault tree has been closed out 100% and work is continuing on the PBIS fault trees. SRB R&ME supported the IEA ART by recommending and approving Corrective Actions for the qualification failure of the IEA harness assembly. SRB R&ME did not concur with the ART recommendation of no vibration penalty testing being necessary due to SRB R&ME locating requirements in NSTS 5300.4(1D-2) and the IEA Qualification Test Plan. The issue was resolved by the Senior Material Review Board.

R&ME reviewed and processed COQ A-STR-7129-1 this quarter. This particular COQ was for the newly built SRB External Tank Attach (ETA) Rings. R&ME also provided launch support for STS-114 on July 13, 2005. One Interim Problem Report (IPR) was issued and processed before the mission was scrubbed. R&ME provided additional support at MSFC's HOSC for the successful launch of STS-114 on 7/26/05.

RSRM R&ME

R&ME assisted in the development of one page reports to support the STS-121 CoFR (Certificate of Flight Readiness) process this quarter. Post-flight evaluation of RSRM-92 (STS-114) revealed a large number of small Acrymax paint/RT455 and TPS cork liberations. The resulting PRACAs and IFAs generated by this debris liberation were open CoFR issues which had to be addressed. One page reports consist of background, risk migration actions, constraints and S&MA recommendation/rationale. R&ME reviewed ATK –Thiokol's TWR-10162, Reliability Plan for Space Shuttle Solid Rocket Motor Project, for compliance with the requirements in NSTS 5300.1(1D-2) and NSTS 22206. Revision N revised change notice terminology, reference document numbers as well as updating ATK organization charts, supplier alert response time and the PRACA flow chart. This plan was approved by the RSRM project manager for use on 9/12/05.

SSP R&ME Integration

R&MEI supported all of QD20's Launch Commit Criteria [LCC] Working Group meetings and Operations and Maintenance Requirements and Specifications (OMRS) Working Group meetings in order to address changes associated with either the next flight or non-vehicle specific changes, and also evaluated several integrated change requests with comments/feedback provided to QD20. R&MEI provided standby support to QD20 during the STS-114 countdown on July 13, 2005, attended the MP71 Threats-Concerns Meeting and provided S&MA inputs as required, in order to focus on the list of concerns regarding STS-121, supported the regular OMRS Working Group by recommending the disposition of three OMRSD changes applicable to R&MEI: MS16785, S00 - SRB CAMERA REF DESIGNATION UPDATE; OV16076R1, V41 - MPS INSPECTION; MB16784, B00 - SRB CAMERA VIDEO CHECK. R&MEI also reviewed preliminary documentation for the Infrared Projector Ground System and provided comments to QD20 on its System Requirements Document and Systems Integration Plan, supported the OMRS Working Group by coordinating JSC comments concerning MV16837, V41 - SSME LRU RETEST TABLE CLEANUP, with MSFC S&MA and MP71, and supported the regular LCC Working Group meetings associated with: LCN 01124R02, Scrub of SRM-06, RSRM Field Joint LCC, LCN 01164R02, Scrub of SRM-01, -02 RSRM S+A Device and SRM-04 RSRM Chamber Pressure. R&MEI reviewed and assessed LCN 01164R01; Scrub of SRM-01, -02 RSRM S+A Device and SRM-04 RSRM chamber pressure. This LCN was revised per comments and agreements and returned to the Working Group in approximately two weeks. R&MEI also evaluated one integrated change request and provided comments as a result to QD20 in regards to the Infrared Projector Ground System.

QD30

International Space Station (ISS) R&ME

R&ME finalized its ECLSS Wiring Harness/FMEA cross-matrix this period. The final version has been distributed to all applicable program personnel for review and comments. R&ME also followed up with JSC's R&ME counterpart designated to verify that what is included in the matrix fully meets the intent of action item RMWG-04 from the last R&M Working Group meeting and any additional comments that may come out of the JSC review. No feedback has been received to date. R&ME created the ECLSS Wiring Harness FMEA/Function Cross Matrix

in order to list each of the pin-to-pin signal/power/data lines and then to relate each of these lines to a given FMEA worksheet number.

R&ME completed the line identification for the ECLSS Oxygen Generation System (OGS) and provided reliability direction regarding a scheduled FMEA activity involving testing of the OGS and its interface with the Ground Support Equipment (GSE) that will be utilized. R&ME facilitated a meeting to review the OGS GSE Vacuum Pumping Cart hardware and potential failure modes, and the hardware's failure mode impact(s) to the flight hardware. Upon completion of this review the OGS GSE Vacuum Pumping Cart failure mode's impact to the flight hardware have been finalized. The ECLSS WRS and OGS FMEA/CIL analysis documents are currently are now in a draft state. R&ME is reviewing these current drafts (completed a year ago) and updating them based on recent design updates, updates to the Hazard Reports, and updates from Hamilton Sundstrand's FMEAs.

R&ME is presently reviewing the most current MSRR-1 FMEA (MSRR1-DOC-0062) which was written by ISS R&ME in March, 2002 and released at an IPL CDR level. R&ME is incorporating any needed updates/changes to this FMEA. The subsystem drawings for the Master Controller have been obtained, which will lead to requests for additional subsystem drawing sets. An additional follow-up with Design Engineering and System Safety will also need to take place.

R&ME is now performing line identification for the Urine Processor Assembly (UPA). The Water Processor Assembly (WPA) pin-to-pin designation cross-overs are now complete on the FMEA. An initial draft of the FMEA has been forwarded by MSFC R&ME to JSC R&ME for their review and initial inputs.

R&ME continued as an active member of the Space Shuttle Program (SSP) Reliability and Maintainability Working Group and the International Space Station (ISS) Reliability and Maintainability Panel this quarter, held jointly each week with Johnson Space Center (JSC) to ensure that R&M programmatic and technical requirements are implemented within each program.

R&ME Training

R&ME department hosted a three day Mechanical Design Reliability course given by the Reliability Analysis Center (RAC) at MSFC. This training, presented by the Reliability Analysis Center (RAC), covered a wide range of objectives specifically related to mechanical design reliability. These objectives included understanding the impact of reliability engineering on product development, usage, service and life-cycle cost, introducing techniques and tools to design-in and improve reliability and showing how reliability and maintainability practices and metrics should be an integral part of the product development process.

R&ME also participated in the HEI Probabilistic Risk Assessment (PRA) training on 8/19/05. The course presented only the basics of PRA; an advanced PRA course will be provided at a later date. Among the items discussed were the general steps in performing a PRA and key components. Examples which included fault trees, event trees as well as Bayesian updating and simulations were also modeled.

R&ME attended an AS9100 Aerospace Competency and Aerospace Auditor course held at the Marshall Institute 8/15-19/05. The course centered on the additional criteria for auditing aerospace firms and vendors above and beyond the ISO 9000 requirements.

4.2.2 Problem Assessment Center (PAC) Operations

HEI's PAC personnel processed and coordinated disposition of problem reports; coordinated the MSFC Problem Assessment System; coordinated problem processing; participated in the STS-114 scrubbed launch attempt on 7/13/05 and successful launch of 7/27/05; supported one launch simulation; provided open work problem and ALERT data for the STS-114 L-2 launch readiness review; completed and distributed revisions to the Constellation PRACA Methodology document based on Constellation System Integration Board (CSIB) and development team input; and operated the Corrective Action System (CAS). The PAC received and entered 38 new problem reports (PR) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of fourteen PRs, received eight prime contractor closure recommendations, supported MSFC full closure of six PRs, coordinated non-problem closure of two problems, and performed 905 individual PR database updates and reviews (mainly due to a Shuttle PRACA clean-up activity coordinated by the Shuttle Program PRACA Working Group). We conducted three SSME problem review boards (PRB) resulting in dispositioning ten problem reports. The PAC generated or updated trends for MSFC Shuttle problems submitted as newly opened or for closure, and, in coordination with QD40 and QD20, refined, implemented, and maintained a standard method foi recurring problem analysis and identification. The PAC also generated, evaluated, and distributed monthly problem trend evaluations and supporting charts. The PAC reviewed five requests for access to the MSFC PRACA database and granted all of them. The PAC requested and monitored implementation of enhancements to the MSFC PRACA data system, including direct download of several reports to Excel spreadsheets, addition of page breaks between problem reports, and increasing the size of the IFA identifier from 12 to 14 characters to provide full compliance with Shuttle PRACA requirements. The PAC also identified an omission in Shuttle IFA problem processing for Integration IFAs; clarified the issue with SE&I, MSFC and Shuttle Program Assurance; developed a proposed solution of adding SE&I as a new project into MSFC PRACA to house integration IFAs; obtained approval of the proposed solution among the various parties; developed implementation details with SE&I; and worked with HEI Information Management in checking out the first phase of the MSFC PRACA database change.

In support of the Shuttle Program Assurance Office, we represented MSFC in four PRACA Working Group teleconferences (on data clean-up, common hardware reporting, multi-element problem processing, and integration in-flight anomaly tracking) and at two Shuttle Common Hardware teleconferences (at which the common hardware change request was finalized and we identified a discrepancy in the common hardware list that caused erroneous historic common hardware data counts). The PAC also advised Shuttle Assurance, contractor, and/or Shuttle Program Assurance personnel regarding PRACA reportability and processing of In-Flight Anomalies, and reviewed and red-lined contractor procedural changes to fully implement NSTS 01826 Rev J Shuttle PRACA Requirements. The PAC generated and distributed a weekly open PRACA problems and ALERTs metric to show progress toward resolution of all issues prior to

shuttle missions. At the request of the Shuttle Program Quality Panel lead, we participated in the preliminary design review (PDR) of USA's proposed Single Nonconformance (SNC) Integrated PRACA (iPRACA) system that will merge all USA problem systems into a single data processing system by 2007 and may then be expanded to encompass all Shuttle Projects and contractors.

In support of the Constellation System (CS), the PAC led review of CS Integration Board comments to the Constellation PRACA Methodology document and incorporated those changes that were approved by the PRACA Methodology Development Team. The PAC also represented MSFC and the Constellation PRACA Program on the NESC PRACA Taxonomy Working Group, charged with defining needed data elements and coding systems for the Constellation PRACA by the end of calendar year 2005. HEI's PAC specifically developed several Constellation case use scenarios that will be used by the team as a means of evaluating the need for specific data fields in the system.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly newly opened/closed problem summaries, weekly SRB PRACA and ALERT activities and status reports, and quarterly Open Problems List (OPL). The KSC Daily Reports were maintained even during the Rita hurricane webPCASS outage by MSFC's direct access into KSC PRACA. Special activities included: (1) extracting and providing JSC Orbiter sensor box problems from webPCASS; (2) providing MSFC S&MA with two specific SRB quality escapes directly from the SRB Nonconformance Information System (NIS); (3) providing the SSME Project HPOTP inlet pressure vein cracks/linear indication problems; (4) briefing the non-destructive evaluation (NDE) technical warrant holders (TWH) working group on Shuttle, ISS, and Constellation PRACA systems; (5) providing recirculation isolation valve problems to SSME Assurance; and (6) providing and encouraging contractor reporting of STS-114 IFAs presented to the Program Review Control Board (PRCB) in the master SE&I IFA list.

In problem trending, th PAC continued to implement our improved techniques for recurring problem identification, analysis, and presentation and to enhance automation of steps in the process. The PAC presented the technique to various Shuttle Assurance Project teams. The PAC also continued to work with Shuttle Program Assurance, the Shuttle PRACA Working Group, MSFC and JSC Reliability, and the NESC Data Mining and Trending Working Group to define a common approach to trending for use across the entire Shuttle Program.

In implementation and operation of the MSFC Corrective Action System (CAS), the PAC received 35 potential CAS reports, screened 31 draft Recurrence Control Action Requests, elevated 11 to new Recurrence Control Action Requests (RCARs), coordinated 22 point of contact (POC) responses, and facilitated 12 Corrective Action Boards (CABs) resulting in closure of ten RCARs. In response to an audited finding by NQA, the PAC worked with CAS software support to define a new mandatory field for identification of objective evidence of corrective action, coordinated a process for the QD40 audit group to follow-up on effectiveness of RCAR closures at their next internal audit of the involved organization, and submitted revisions to MPR 1280.4, MSFC CAS Operation, to include these changes.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as we coordinated MSFC ALERT processing and participated in the NASA and general Government-Industry Data Exchange Program (GIDEP) activities. HEI received and distributed 21 ALERT announcements for MSFC review and obtained 1,549 responses from MSFC project, contractor, and laboratory contacts. HEI also continued to establish organizational points-of-contact for the transformed MSFC organizations in their new departments/directorates. HEI ALERT support personnel (1) reviewed and approved eight new MSFC ALERT database accounts via the TPS security; (2) generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction; and (3) maintained a low delinquent response level. The MSFC ALERT personnel attended the August GIDEP Business Session in Norco, CA with the new MSFC ALERT Coordinator and, while there, supported the NASA ALERT Coordinator and other NASA Center ALERT NASA and contractor support personnel in development of requirements for a common NASA Advisory data system. The PAC also provided monthly ALERT data to the MMS Implementation Team, to the monthly Management Safety Review (MSR), and to assist in STS-114 launch readiness evaluation.

4.3 Quality

Space Transportation

Space Shuttle Main Engine (SSME) Quality Engineering (QE) evaluated Program, Project and contractor engineering changes for quality impacts and participated in daily Program and Project meetings. QE traveled to Rocketdyne to support project Configuration Management Audit and to Stennis Space Center to witness the 380 second Shuttle Main Engine Test. QE continued to participate in High Pressure Turbopump knife edge seal investigation.

Solid Rocket Booster (SRB) QE continued to support the BSM graphite throat Factor of Safety (FOS) tiger team meetings. QE continued day-to-day activities which included support to weekly Booster Separation Motors (BSM) Integrated Process Team (IPT) meetings, BSM Plume Characterization Team, Return to Flight Action Review, and RTF Technical Interchange Meetings. QE prepared and presented technical issue briefings to S&MA upper management.

SRB QE continued to support to the Automated Dynamic Acceptance Procedure Test Stand (ADAPTS). QE participated in the ADAPTS Test Readiness Reviews and technical interchange meeting.

SRB QE continued participation in the SRB ATK Booster Separation Motor (BSM) Alternate Source Team activities. This has included support of Readiness Reviews (TRR) and technical interchange meeting to resolution of open review item discrepancies.

SRB Pyrotechnics supported the Pyrotechnics S&MA in the review of SRB Phase II documentation of Frangible Nut Booster Cartridge redesigned, the Confined Detonating Fuse Assembly (CDFA) shelf life extension test (SLET) radiographic film evaluation, and the STS-114 Frangible Nut Spherical Radius deformation NASA Standard Initiator Pressure Cartridge (NSI-PC) Phase III Flight Certification Review.

SRB QE supported the Integrated Product Team (IPT) Integrated Electronics Assembly (IEA) Supportability Upgrade Team and the Lead Free Solder Project Joint Workgroup for Pollution Prevention.

Shuttle Element QE's worked to development Quality Plans per NSTS 60538 for each MSFC Shuttle Element.

External Tank (ET) QE continues to support the Excitation Power Box (EPB) Instrumentation activity, providing quality requirements and receiving inspection instructions as required.

ET QE supported ECOS (Engine Cut Off Sensor) investigation from KSC during the Shuttle launch activity. QE worked a Bi Pod bolt issue during launch and assisted in the development of flight rationale.

Reusable Solid Rocket Motor (RSRM) QE continued support to a Requirements Flowdown Audit conducted by Headquarters. This audit assessed the flowdown of requirements from NSTS 5300.4(1D-2) to the prime contractor and sub-tier suppliers. QE participated in the RSRM Pre-Flight Assessment for STS-114.

Software Assurance

Software Assurance (SA) reviewed the MSRR-1 Payload Laptop Computer (MPLC) Software Requirements Specification (SRS). SA provided inputs to the Software Review Board (SRB) regarding the baselining of the MPLC System Requirements Specification and the MSRR Software Development Plan (SDP). SA also attended the MPLC System Requirements Review (SRR) and is reviewing associated documentation. Any findings will be noted in a Review Item Discrepancy (RID). SA witnessed formal verification and validation (V&V) testing of MSRR Software.

SA presented an overview of the Telelogic Dynamic Object-Oriented Requirements System (DOORS) requirements management tool to the Flight Software Branch EI32. DOORS has been utilized by SA to show bi-directional traceability by creating formal modules containing all MSRR system level Integrated Rack Requirements assigned to verification by simulation, Flight Software Requirements Specification (SRS), and EI32 test procedures.

ISO/AS9100

QE has continued to play a key role in ensuring the maintenance of ISO 9001 and AS9100 at MSFC during this time period. Efforts have dealt with continuing implementation of ISO 9001 and AS9100, maintenance of documentation, and planning and support for the NQA registrar surveillance audit, including escorting during the audit, and follow-up and closure of corrective actions. QE provided general ISO and AS9100 support, including Integrated Management System Board (IMSB) meeting preparation; reviews of both MSFC and NASA Agency documentation; and consulting support on internal audits, continual improvement, customer satisfaction, quality objectives, management review, and other aspects of ISO 9001 and AS9100 to various MSFC Organizations.

QE participated in a two-day AS9100 aerospace industry training class in preparation for an AS9100 lead auditor training. QE participated in a NASA Agency Management Systems Working Group (MSWG) meeting at NASA Headquarters on 8/23-25/05.

Payloads
QE performed drawing reviews, procedure reviews, test readiness reviews, and procurement reviews, inspection requirements, shipping requirements, and supported team meetings for the Environmental Control Life Support Systems (ECLSS), GLAST Burst Monitor (GBM), Material Science Research Rack (MSRR), Solar-B, and Microgravity Science Glovebox (MSG) projects. QE continued review and provided comments for safety verification closures for ECLSS. QE provided quality expertise to Material Review Boards for ECLSS, MSRR and MSG.

QE continued to provide support to the DART Spacecraft failure investigation. QE continued to assist in the formulation of a Preliminary Mishap Investigation Board, (MIB), including implementing the approved DART Mishap Investigation Procedure. QE was responsible for the impoundment of all inventories in the Mission Operation Center and its subsequent delivery to MSFC for reference information to the formal MIB. Since the mishap, QE has assisted the DART MIB Chairman in all the logistics required to conduct the mishap investigation review in a timely manner.

Inspection and Test
Quality Assurance (QA) personnel supported the ET/SRB Return to Flight testing and inspection activities and continued to support the manufacturing and inspection of ET Foam test specimens. QA personnel witnessed the application of Hypalon onto Hentzen topcoat qualification test panels.

QA personnel supported the Environmental Control Life Support Systems (ECLSS) Project with inspection and data review activities, particularly by inspecting/reviewing work orders and data for the Distillation Assembly, Water Recovery System (WRS) Rack, and the Oxygen Generation System (OGS) Rack Assembly sub-tier work orders. QA monitored program critical hardware moves of Rack #1 and inspected/reviewed the WSTA Qualification Unit Acceptance Data Package.

QA personnel supported the Microgravity Science Glovebox (MSG), Material Science Research Rack (MSRR), Lab-On-a-Chip (LOCAD), Solar-B, g-LIMIT, and GLAST Burst Monitor (GBM).

QA personnel provided hardware inspection, test surveillance and document review support to the following QD10 projects: External Tank Return to Flight Testing, 24" Solid Fueled Motor High Pressure Grain Test, and weld inspections on the new facility gaseous hydrogen piping at Test Stand 115.

Receiving inspection was performed on hardware for multiple flight projects, assuring compliance to all requirements.

4.4 Information Management (IM)

During the quarter, IM completed the SHE Training Catalog (STC) application that allows SHE personnel to input and maintain catalog information and provides a method for supervisors to evaluate SHE training needs for all personnel. IM demonstrated STC and the Certification Tracking (Certrak) applications to the S&MA Director from Glenn Research Center (GRC) who expressed an interest in deploying the applications at GRC. IM also released the Construction module of the Safety, Health and Environmental Tracking (SHEtrak) application and created a help guide for submission of an abatement plan. IM revised the Independent Assessment Database (IADB) to a web-based program and modified it from a single-flight system for Return-to Flight issues to an application for tracking items/components and their issues for any flight. The application was released to the customer for beta testing (AOE d). IM also developed the initial module of the Management Action Reporting System (MARS) and provided it to QD01 for review and comment.

Application and site modifications were prolific during the reporting period. IM completed numerous modifications to Problem Reporting and Corrective Action (PRACA) reports, search, and add/update modules and developed new modules that insert graphs into reports. Modifications included the capability to download numerous reports to excel files; incorporation of user help; completion of new reports (AOE b); and revision of the contractor upload programs. One PRACA modification involved a quick-turn-around request supporting potential new customer use. Concurrently, IM revised the Inventory of Hazardous Operations (IHOPS) application, update program, database and on-line training course to incorporate improvements identified during a study of hazardous operation management. IM also incorporated a self-initiated improvement in IHOPS that will help users identify drafts that are approaching the due date or are overdue for submission. The Supervisor Safety Web Page (SSWP) program was revised to incorporate customer requested changes. In addition, the program that populates personnel and organization data for SSWP was modified to remove an exception; the change corrected over 90% of SSWP personnel list errors. IM released three versions of the S&MA Travel System. Modifications included improvements to the financial reporting functionality and preparations for the budget shift into FY06. IM revised the menu, security measures and email functionality in the S&MA Customer Feedback Survey. IM also revised the IM Customer Survey Application, which is used to produce and manage surveys by numerous customers including the S&MA Peer Awards Team. Revisions included improvements to the reporting functionality, addition of a download to Excel function for all survey data, and improved user customization. IM also developed an application and web site supporting the S&MA Peer Awards. IM incorporated significant modifications to the Statistical Tool for Analyzing Risk of Space-Exploration (STARS) program, which is being developed for the S&MA Advanced Projects Assurance Department to assess mission & component risk on emerging technology. Other modifications included revisions to the Audited Vendor List/Limited Vendor List/Project Specific Approved Supplier List (AVL/LVL/PSASL), Personnel Mishaps and Close Calls (PMCC), Building, Stamps, and Safety Smart applications as well as the Cargo Assurance website. The IM Common Framework was also revised to incorporate improvements suggested by IM team members; the improvements will further reduce operating costs because the change in one location will populate all pages using the code.

Other activities included support of the STS-114 Launch Honoree events and System Administration activities including installation and configuration of Entrust SSL Web certificates for five S&MA Web servers and installation of PHP: Hypertext Preprocessor (PHP) and helper applications. In addition, IM received 63 and closed 51 support requests, processed 188 access requests, revoked privileges for approximately 200 terminated personnel, and maintained a combined approval rating through feedback mechanisms of 99.4%.

4.5 Human Exploration and Development of Space (HEDS) Assurance

The Independent Assessment (IA) Management Information System Database is being used as an information conduit with our NASA customer. The IA analyst for each element updates the entries for his element as changes in issues, concerns, and status changes. The HEI Information Technology team has updated the database to be web-based and more user friendly. Currently, the IA analysts are inputting data to the database.

4.5.1 International Space Station (ISS) Independent Assurance

As a result of schedule, cost and technical problems with the Regenerative Environmental Control and Life Support System (ECLSS) being developed by Marshall Space Flight Center (MSFC) for use on the International Space Station (ISS), the ISS Program conducted an Independent Assessment (IA) Panel Review of the project. IA participated as a member of this panel. The ECLSS project presented an overview of each of the components, the hardware buildup, and the testing and problem areas to the panel. As a result of this review, the panel recorded 26 findings and recommendations. The panel found that the two major areas of concern were 1) the sensitivity of system sensors and that that they were single point failure possibilities, and could shut the system down; and 2) the lack of a lab Qualification unit that could simulate any problems that might be experienced on orbit. All of these findings will be presented to the ECLSS Project and Program managers for their review and disposition.

4.5.2 Space Shuttle Independent Assurance

The out-briefing of the assessment (MH-4007) of the Procurement Quality Control of the United Space Alliance's (USA) Solid Rocket Booster (SRB) has been presented to the SRB Project. IA is now waiting for the project responses to the findings and observations. When these responses are incorporated into the report and the report submitted to the project, this assessment is completed.

During the checkout activities conducted while loading cryogen into the External Tank (ET)-121, off-nominal behavior of the Engine Cutoff Sensors (ECO) sensors was observed. Sensor number 2 of the Liquid Hydrogen (LH2) tank did not respond correctly to the simulation dry condition and subsequently did not respond correctly when drained until 16 minutes after the other three sensors indicated the tank to be dry. An aggressive troubleshooting plan was implemented where several problem reports were generated indicating potentially unacceptable conditions. These conditions were related to grounding, suspect electronic components and electromagnetic interference. The testing did not identify a definite cause of the erratic ECO sensor behavior; therefore, the condition was considered to be an unexplained anomaly and was presented to the STS-114 Flight Readiness Review (FRR) community as such. The Program decided to proceed with tanking of the ET and assess the ECO sensor condition at that time. The Shuttle Program

established Anomaly Resolution Teams in an effort to locate and fix the cause of the engine cutoff sensor (ECO) #2 anomaly. Thirteen teams were formed, and daily meetings were held with the Program Systems Engineering and Integration Manager to review and assess the team results. Information and results from these meetings was presented to the STS-114 Mission Management Team (MMT). Although no root cause was found during the extensive troubleshooting and analysis, the MMT decided to proceed with the launch of STS-114 on 7/26/05. The IA Team (IAT) recommended that the ET project continue to pursue definition of the root cause of the ECO sensor anomaly since under certain conditions, ECO sensor failures could result in catastrophic oxygen rich shutdown conditions. The sensors responded as expected and resulted in no threat to the STS-114 flight. In this flight the vehicle velocity was achieved prior to depleting 95% of the LH2, therefore the ECO sensors were never polled and did not play a part in the SSME shutdown.

In addition, IA worked with the QD40 Organization in the development of the Common Cause Fault Tree for the ET LH2 ECO sensor to identify any common causes which could explain the anomaly noted with the ET LH2 ECO sensor. There were several common causes which could result in the loss of two or more of the LH2 ECO sensors, but the team could not identify any common causes which would result in the particular anomaly noted in the operation of the LH2 ECO sensors.

During the STS-114 flight, imagery revealed foam loss from three locations of the Ice Frost Ramp (IFR) on the ET. An investigation team has been assigned to define the cause of foam loss and recommend corrective action. A fault tree has been completed and analyses are underway to close those proven to be non-contributors to the foam loss. To date no certain foam loss cause has been identified. The team is continuing reviews, analyses and test planning to complete the investigation. Four tests of the IFR from the Integrated Fault Tree Testing Requirement matrix have been identified to pursue characterization of the foam and addresses failure modes. IA is participating in the preparation of two of the Test Plans (IFR-006, a plan to dissect the IFRs on ET-122 located at the Michoud Assembly Facility (MAF) to determine the presence of voids with the bladder mold process) and (IFR-005, a plan to build a transparent mold for the IFR to observe the flow and the tendency to form voids as the foam is poured). These two Test Plans have been base-lined and are in the process of being reviewed by the IFR Team.

IA participated in the STS-121 Space Shuttle Main Engine (SSME) Pre Flight Assessment (PFA), Safety & Mission Assurance (S&MA) review that was held at MSFC on 8/10/05 in preparation for an anticipated 9/22/05, launch. Pratt & Whitney Rocketdyne, Inc. presented a hardware assessment including designated components, hardware age, and hardware and software changes since the last hot-fire. There was only one major technical issue that is still being investigated and that concerns out of family nozzle 5007 tube ruptures during recent acceptance testing at Stennis Space Center. Prior to the hot firing of nozzle 5007, a special 770 degree, 5 hour bake out was performed to remove discrepant Uralite near the aft manifold. This bake out caused a reduction in ductility of the braze material that resulted in the rupture of four aft end hot wall tubes. Because this failure is not totally understood, the nozzle was removed from STS-121, and is not a flight issue. The investigation of this failure is continuing. There were no other issues pending and the S&MA PFA Board agreed that the SSME's were ready for flight.

IA participated in the STS-121 SSME Project Flight Readiness Review (FRR) that was held at MSFC on August 12, 2005. Pratt & Whitney Rocketdyne, Inc. presented the SSME "Hardware Assessment", "Performance Predictions", "Prior Flight/Ground Test Anomalies", "Technical Issues", "System Safety Risk Assessment", and "Quality/Reliability Assessment". This review went smoothly with very little discussion and the Board agreed that the SSME's for STS-121 were ready for flight. There are no open actions from this review.

IA participated in the Reusable Solid Rocket Motor (RSRM) Delta-2 S&MA PFA for STS-121. Since the motor set on STS-121 was part of the original configuration of STS-114, this PFA was an assessment of deltas due to changes since STS-114. The only significant issue voiced during the PFA was in the list of post-flight assessment activities, the inspection of the inactive stiffener stubs was not listed as a constraint to flight of STS-121. The board chairman requested that this be brought forward at the RSRM STS-121 Project FRR since this was a fairly major change to configuration for the RSRM on STS-114. IA identified no issues during this review.

IA participated in the RSRM Delta Project FRR for STS-121. Since the motor set on STS-121 was part of the original configuration of STS-114, this FRR was an assessment of deltas due to changes since STS-114 and a quick review of the status of other Certification of Flight Readiness (CoFR) items. There were no significant issues raised during this Project FRR. IA identified no issues during this review.

The RSRM project had a chart flip through prior to the Element Acceptance Review (EAR) for Motor Set 94 which is currently planned for STS-116. The presentation included discussions on In-flight Anomalies from the STS-114 flight as well as other open work, changes since the last flight open Problem Reporting and Corrective Action (PRACA) items, etc. There were no major issues identified which would prevent the acceptance of this hardware.

S&MA at NASA Headquarters has begun a process called "Compliance Verification" to verify that headquarters S&MA requirements are being flowed down and complied with at the NASA centers and from there to the programs, projects, and contractors. To this end, they have developed processes to conduct four types of audits and reviews: 1) Institutional/Facility/ Operational (IFO) audits to verify compliance with requirements documents related to S&MA management, institutional and operational safety; 2) Institutional Program Support Audits (IPS) to verify compliance with requirements documents related to institutional program support processes; 3) Programmatic Audits and Reviews (PA&R) to verify compliance with the program Baseline Requirements Set (BRS) and to verify compliance with requirements documents pertaining to program class; and, 4) the Safety and Mission Assurance Readiness Review (SMARR) to support decisions by senior S&MA managers. The SMARR process was used for STS-114 as well as for other activities which the Chief, OSMA, needed support. MSFC has had an IFO audit earlier this year. The Reusable Solid Rocket Motor project was chosen by headquarters to be the first project subjected to a PA&R. Phase I has been completed and outbriefed to MSFC and Thiokol. Phase II will commence sometime this fall. MSFC Independent Assessment (IA) will be part of the Phase II PA&R. A proposed list of projects on which to conduct PA&Rs during FY 2006 was requested by headquarters and has been supplied. IA worked with QD40 personnel to develop this list.

4.6 Project Assurance

QD10

Project Assurance Engineering (PAE) personnel performed a variety of tasks in support of Reaction Creation Engine (RCE) testing at White Sands Test Facility (WSTF). PAE supported a test procedure table top review and performed a review of the Risk Assessment Statement, submitting numerous comments to qualify for the mishap reporting exceptions contained in NASA Procedural Requirements for Mishap Reporting, Investigating and Recordkeeping. The risk assessment statement addresses and provides mitigation on four primary hazards directly related to Option 1 test experience. The issues addressed were, failure of the primary propellant valves Vespel seat seals, failure of spark plug ceramic (cracking/ chipping), burn-through or structural failure of chamber, and over-pressurization of the horizontal engine upon ignition (hard start). Due to numerous facility issues (leaking valves, damaged oxygen feed line, leaking thermocouple line fittings) the schedule for Cold Flows TRR (Test Readiness Review) has continued to slip, to take place no earlier than late September.

PAE continued to provide a variety of project assurance expertise to the Integrated Powerhead Demonstrator (IPD) testing project. Fuel preburner instability remains the primary concern heading into further IPD testing. Aerojet's initial structural life assessment of the preburner indicated a very limited life but a more complete MSFC structural assessment and combustion stability analysis provided additional margin, indicating sufficient life to continue testing. A number of issues remain unresolved and there is considerable disagreement over the actual range of instability. IPD management will present the issues to Steve Cook's office at which time a decision will be made on future testing. Project Assurance has reviewed the latest analyses and will support at least one additional test but, given the level of uncertainty involved, considers this test "high risk" and has recommended that it be reflected as such in the Risk Assessment Statement. The IPD development engine remained in the stand during hurricane Katrina and, from all indications, was undamaged by the storm. Given the storm related damage to the facility and surrounding areas it is not possible to forecast when/if testing will resume so steps have been taken to secure the engine in the stand for an indefinite period of time.

PAE has submitted a draft mishap plan to delegate Quality Surveillance activities to the on-site Defense Contract Management Agency (DCMA) for the Pratt and Whitney Common Extensible Cryogenic Engine, RL-10 development testing at the P&W facility at West Palm Beach. The technology demonstration testing, scheduled to begin April 2006, would utilize a modified "workhorse" RL-10 engine, to demonstrate the throttling capability of the engine for potential use in future programs. Given that P&W had no initial plans to invoke specific QA inspection requirements on this technology development effort, S&MA recommended a streamlined set of requirements to be delegated to DCMA. Project Assurance has recommended that the current GMIPs (Government Mandatory Inspection Points) be retained but has agreed to reevaluate those requirements for applicability on a case-by-case basis. Internal P&W safety personnel will support the test facility itself but DCMA will be asked to assess overall test readiness, evaluate test results and actively participate in any test failure/anomaly resolution. The Quality Surveillance Plan is currently being reviewed by project management before being forwarded to the contracting officer for inclusion in an amended Letter of Delegation (LOD).

PAE continued to support the Constellation S&MA Integrated Discipline Team (IDT) for the development of S&MA Requirement documents and specifically the Quality Assurance Requirements document (082541). PAE participated in the planning and conduct of the S&MA IDT meetings held at the Johnson Space Center on 7/25-29/05. These meetings were held to assess the progress being made with respect to revising the Constellation Program's S&MA baselined documents in preparation for the Phase 2 of the Crew Exploration Vehicle (CRV) Request for Proposal (RFP) that will be made public in September, 2005. There were several decisions made during the IDT meetings which will require further work on the S&MA documents and specifically the IDT's desire to combine Safety, Reliability and Quality Assurance requirements into a single document for use on the Crew Exploration Vehicle (CEV) Program. An assessment has been completed for the feasibility of restructuring the Constellation Program's baselined QA Requirements document to be more in-line (and in compliance with) the Aerospace Standard AS9100 for Quality Assurance programs. It was apparent from the review that the document could be restructured as discussed at the S&MA IDT at JSC on 7/26-29/05. However, there has been no appropriate decision to proceed with this document restructuring to date. There has also been continued PAE participation in the development of S&MA requirement documents in general with respect to the content that is necessary for the various Anticipated Statement(s) of Work that will most likely be forthcoming in the near future.

PAE also supported the development of S&MA and Quality Assurance specific comments to a draft Systems Requirements Document (SRD) that is being pursued for possible use on the Constellation Program / Shuttle (element) launch vehicle. PAE also reviewed the Exploration Crew Launch Vehicle (CLV) Systems Requirements Document (SRD) and provided necessary comments. PAE also continues supporting QD11 in the preparation of the S&MA input into the Crew Exploration/Crew Launch Vehicle Interface Requirements Document (CEV/CLV IRD). In addition to S&MA, other disciplines such as Operations, Propulsion, Thermal, Avionics, etc., are preparing the interfacing requirements applicable to their disciplines.

Additionally, the PAE has been assessing the agency's S&MA Policy documents to determine which requirements are programmatic in nature and which are technical in their scope and intent. This exercise will allow a better understanding of the parentage of S&MA requirements that should be included in future Constellation Programs. PAE reviewed "Robotics in the Vision for Space Exploration" and provided comments.

PAE reviewed JSC 62809, "Human Rated Spacecraft Pyrotechnic Specification" and provided comments to QD11. PAE continues supporting QD11 in the preparation of the S&MA input into the Crew Exploration/Crew Launch Vehicle Interface Requirements Document (CEV/CLV IRD). In addition to S&MA, other disciplines such as Operations, Propulsion, Thermal, Avionics, etc., are preparing the interfacing requirements applicable to their disciplines. In addition, PAE continues to assist in updating the Exploration level S&MA requirements documents with emphasis on the Exploration S&MA Plan.

PAE participated in S&MA document planning meetings for *In Situ* Fabrication and Repair (ISFF) for fabrication, habitation, and repair, and *In Situ* Resource Utilization (ISRU) technology concept studies. Some customer interest had been expressed about invoking Industrial Systems

Safety for laboratory testing. PAE investigate potential Industrial Systems Safety Resources. Given that these concept studies are still Pre-Phase A it was determined that Preliminary Hazard Analysis (PHA) would cover the needs of the studies. It was also determined that invoking Industrial Systems Safety was not needed for laboratory testing. The laboratory's Operational Instructions (OI) and Marshall Work Instructions (MWI) along with their Job Hazard Analysis should suffice. PAE reviewed ISFR documentation and ISRU PHAs.

It was determined that the ISFR team wanted S&MA requirements analysis to enable the ISFR team to determine how much S&MA requirements would drive their concepts. Specifically they wanted to know which Constellation Systems S&MA requirements will be applicable to their effort in terms of establishing a 'requirements pull.' They were especially concerned as how to certify an item produced from lunar resources for use as a Criticality 1 item. They were also looking for the S&MA other 'big issues' with their processes and products. PAE reviewed ISFR documentation to develop issue awareness. PAE assessed Constellation Systems S&MA documents to establish an analysis priority to evaluate these documents for the ISFR requirements applicability. Additionally, PAE attended a meeting with the ISFR Fabrication Team Project Manager to determine their S&MA requirements. PAE also participated in a US Army Mobile Parts Hospital briefing at Teledyne Engineering (TBE) on 9/15/05 to assess their methods of quality control for field parts fabrication. PAE initiated a crude plan to in-situ derived parts certification to support the ISFR Repair and Non-Destructive Evaluation (NDE) teams.

PAE reviewed the Exploration Systems Research & Technology (ESR&T) TR202 Variable Thrust Pintle Descent/Ascent Engine Risk Management Plan and providing comments to support the board approval process.

QD20

PAE participated in the low temperature o-ring design review held at MSFC. A review of the verification approach revealed a through test and analysis program. All Design, including S&MA documentation, was completely assessed for meeting all contact end item specifications. Flaw testing on two full scale test motors will determine o-ring erosion rates that will validate sealing requirements. This change will allow us to better meet day of launch field joint temperature commit criteria.

PAE participated in the RSRM Ordnance technical interchange meeting (TIM) held at MSFC. A review of the ordnance age life, nozzle severance system and the safe and arm device occurred during the two day TIM. A demonstration of the new safe and arm device test console was performed with hands on experience. Various action items were taken and will be dispositioned in the near future.

PAE provided launch support in the HOSC for the STS-114 Mission and helped to successfully and expeditiously work an SRB issue relative to LH2 dripping onto the SRB Forward Strut Cover ("milkcan cover") for a short period during the countdown.

PAE provided support to the CDR-level Special Study review conducted at the SRB APU supplier (Hamilton-Sundstrand, Rockford, Illinois) for two days over 8/4-5/05. A total of 14 Action Items were documented for further action/resolution. The actions covered a wide spectrum of subjects from correction of minor tolerance stack-up errors on component drawings to clarification of environmental load test requirements to formal submittal of a certification testing procedure for the upgrade.

PAE continued to provide support and assistance in the trouble shooting and understanding of a problem with a green gooey substance that has been discovered in the area of the solder joints on the SRB Integrated Electronics Assembly (IEA) harnesses. We were involved in meetings to uncover the cause of the problem that seems to be caused when rosin flux inert catalytic activators combine with copper oxide to form an abietic acid compound that is green in color and is different from but hard to distinguish from copper oxidation corrosion products. Suspect PRs have been generated and a Process Review Team visited the supplier this period to better understand this issue and the associated plan for going forward and resolving it.

PAE supported the troubleshooting and resolution activities related to excess air in the STS-121 (BI124) Left-hand Tilt TVC system. A series of ground service processing steps has been able to reduce the entrained air to acceptable levels over this period. However, the fault tree closures and Anomaly Resolution Report including root cause and preventive action is still in work. At this point, based upon what has transpired to date, it appears that air introduction from the Ground Servicing equipment used by KSC Ground Ops may be the most likely cause of this problem. Due to the replacement of a leaky Hydraulic Pump in the VAB by USA Ground Ops early on in the flow of this vehicle, an on-pad Hotfire is still to be accomplished on this Aft Skirt as a part of the OMRS required re-testing requirements.

PAE provided support to the Failure Analysis Team activities on S/N 3000008 Fuel Isolation Valve Leakage experienced as a part of BI- 127R pre-ATP testing. Previous leakage fault tree for the valve has been re-opened and the areas of valve design, particularly with respect to the valve's PTFE seat is being re-investigated for cause of leakage. Previous conclusion of transient contamination is being questioned. Current plan is to investigate the failed unit and other representative valves at the supplier the week of 10/3/05.

PAE supported resolution of an issue regarding SRB APU Test Cell 3 Voltage Spike Anomalies. During APU acceptance testing at the supplier, we have been experiencing a sporadic condition where we see stray voltage spikes that are not a requirement violation and that do not fail the unit, or any ATP steps, but that continue to be elusive. These spikes are being researched with troubleshooting continuing. At this point, it appears to a facilities issue, but further testing and evaluation is continuing to evaluate and understand the issue.

4.7 Risk Management and Risk Assessment

4.7.1 Continuous Risk Management (CRM)

During 4th Quarter of Fiscal Year 2005 Continuous Risk Management (CRM) continued its support of the Exploration Systems Mission Directorate (ESMD) (QD10) by providing insight into the proposed Constellation Risk Management Plan. CRM also provided comments to the

ESMD Generic Flow Process for Risk Management and met with NASA's Project Constellation Risk Management Officer to discuss risk management flow process, documentation, the organizational structure of Project Constellation and how it is impacted by the Exploration Systems Mission Directive (ESMD) re-organization.

CRM's support to QD20 continued through its review of the new shuttle risk management plan. CRM had initiated a review of the new plan to help define the shuttle risk process and how it will be applied throughout NASA. One key issue reviewed was the impact of hazard analysis as it affects the shuttle risk management process. The shuttle risk database, SIRMA, has the capability to link hazard reports with the risks that are affiliated with a hazard(s). Currently, the only documentation of this process is a SIRMA training presentation which needs to be translated into the shuttle risk management plan.

The CRM Team provided QD40 support to the recent CRM Team Working Group meetings by: continually revising and updating the CRM Eight Hour course with improved Risk Management Workshop training material, revising and updating the CRM Four Hour course material to reflect a more concise training flow; and revising and updated the CRM Earned Value Management course material to support the CRM Four Hour and the CRM Eight Hour Course with Workshop training material. Other items supported were the: updating of the MSFC Risk Assessment Schedule; reviewing Requirements of NPR 8000.4 & NPR 7120.5C; reviewing ECLSS CRM assessment findings and observations; CRM's risk assessment of the Materials Science Research Rack (MSRR-1) risk management maturity assessment.

In an effort to support the NASA HQ re-write effort of NPR 8000.4, Risk Management Procedural Requirements, a list of discussion points and areas for improvement was submitted to the CRM Team for review and consideration. These areas of improvement included: Description of CRM tools & applications used to implement CRM throughout the Agency to include Probabilistic Risk Assessment (PRA), risk database structure outline, Fault Tree Analysis, Failure Mode Effect Analysis, Critical Item List, and a strong link definition to Hazard Analysis & Hazard Reporting; Incorporate Earned Value Management overview as an integral part of the CRM process as well as an in-depth appendix to establish the link between CRM & EVM in addressing risk costs & risk schedule; Description of the Risk Breakdown Structure (RBS) process and how it is implemented into the CRM process as well as its integration into the Work Breakdown Structure (WBS) of NASA programs, projects, special teams & work groups; Description of Risk vs. Opportunities process and how the identification of opportunities can impact the success of NASA programs, projects, special teams & work groups; Standardization of the Risk Matrix color coding, Probability, Impact & Timeframe; Standardization of the definition of a risk & the construction of a risk statement; Standardization of a risk scoring process; Standardization of the following risk reports: Risk Matrix, Top "N" Risk Report, Risk Summary Report, Risk List & Risk Mitigation Waterfall (burn-down) chart; Clarification on documentation of Accepted Risks vs. Acceptable Risk; Clarification of Closing Risk Process and its integration into the Lessons Learned process and the development of a process to conduct a risk assessment on a NASA project, program, special team or work group.

The MSFC PMC has approved the CRM Team's proposal to conduct a Risk Management Maturity Assessment for the ISS Regenerative ECLSS. To-date, the CRM Team has reviewed

all risk related documentations provided by the MSRR-1 project. These data resources include: CRM Website Questionnaire; Data Collection/Worksheet; Project Risk Management Plan; Risk Reports; Detailed Risk Report; and, Project Schedules.

The MSFC PMC also approved the CRM Team's proposal to conduct a Risk Management Maturity Assessment for the Auxiliary Propulsion Project (APP). To-date, the CRM Team has initiated the Phase I RMMM Assessment for APP to include: CRM Website Questionnaire; Data Collection/Worksheet; Project Risk Management Plan; Risk Reports; Detailed Risk Report; and Project Schedules. The Phase II RMMM Assessment will include: Personal Interviews; Personal Observations; Develop RMMM Presentation to PM; and Present RMMM Presentation. CRM has developed and refined Observations and Findings to include Recommendations that will be presented to the APP Project Team during the out brief. CRM also conducted an interview with the APP Project Team during the week of 08/08/05 and developed its "Draft" APP Risk Management Maturity Assessment Out Brief Presentation based on all the data, observations and interviews conducted during the RMMM Assessment. The Out Brief has been finalized and presentation given to the APP Project Manager. This activity was completed September 2005.

The Phase II part of the MSFC RMMM Assessment is also complete. CRM has developed and refined Observations and Findings to include Recommendations that will be presented to the ECLSS Project Team during the ECLSS Risk Assessment Out Brief, the MSRR-1 Project Team during the MSRR-1 Risk Assessment Out Brief and the APP Risk Assessment Out Brief. The CRM Team met with the ECLSS Risk Manager 8/26/05 to observe a demonstration on ECLSS Risk Assessment Database (RAD). The purpose of this demonstration is to ascertain the type of risk statements, risk context and risk metrics generated with RAD. CRM developed a data structure handout for the ECLSS RAD administrator, N. Hill/NASA to enable her to refine the risk report structure and risk waterfall mitigation data in the RAD. In addition, CRM developed three "draft" presentations on: ECLSS Risk Management Maturity Assessment Out Brief, the MSRR-1 Risk Management Maturity Assessment Out Brief and the APP Risk Management Maturity Assessment Out Brief based on all the data, observations and interviews conducted during our RMMM Assessment along with the tentative final score base on RMMM data findings. These Out Briefs were pre-finalized, and then reviewed with QD40's IA Manager/NASA. Observations & findings scores were refined to present a clearer picture of the ECLSS Risk Management, MSRR-1 Risk Management and the APP Risk Management process. The RMMM Assessment Out Brief was presented to the ECLSS, MSRR-1 and APP Project Managers September 2005.

In an effort to establish a more proactive schedule for NASA & HEI professional certification, the CRM team worked with NASA & HEI management to establish a CRM training schedule as part of the professional certification process. This schedule of CRM classes will help personnel who are seeking certification help focus their training opportunities and will be posted to the Continuous Risk Management (CRM) website.

CRM was an active member of QD40's CAIB/Diaz Action Digital Close-Out Photography (DCOP) Assessment Team from MSFC this quarter. The objective of this team was to help establish digital close-out photography requirements throughout the agency once all reviews and results had been presented to NASA HQ. The team was organized in order to bench-mark the

many NASA/DoD contractor facility's (e.g. Lockheed-Martin in Sunnyvale, CA, Jet Propulsion Lab in Pasadena, CA, Boeing at KSC in FL and Raytheon in Andover, MA.). A final assessment report was completed and successfully presented 9/9/05 to NASA HQ in Washington, D.C. As a result of these efforts NASA HQ has requested that follow actions within the NPD 8730.x draft, include a "NASA Quality Assurance Program Policy". This policy will assure that all NASA programs, projects and Centers utilize DCOP consistently, and to the maximum extent possible.

The CRM Team was represented by HEI at the Risk Management Seminar sponsored by Program Management Institute (PMI). The course covered the following aspects of risk management: Uncertainty; Risks vs. Opportunity; Risk Breakdown Structure (RBS); and Managing Risk Attitudes. The seminar was comprised of members for a variety of industries to include automotive, banking, information technology (IT) and pharmaceutical. The seminar also addressed best practices for identifying project threats and opportunities as well as the PMI approach to risk management. This seminar was very informative and presented alternatives methods of presenting, analyzing and assessing project risks/opportunities. A recommendation is submitted to bring the seminar's moderator to MSFC to assess NASA's CRM process and develop the next stage in NASA CRM process.

The CRM Team was tasked to provide CRM Training in-house to MSFC employees and contractors this quarter. This 4-Hour CRM course re-familiarizes the student with the fundamentals of CRM. The areas of discussion focused on the following: (1) Risk Identification; (2) Analyzing Risks; (3) Plan; (4) Track; (5) Control; and, (6) Communicate and Document Risks; CRM facilitation and assessments. This special CRM training is an integral part of the Professional Development Training Plan (PDTP) requirement established as part of the for certification process for all HEI personnel.

4.7.2 Space Shuttle Probabilistic Risk Assessement (PRA)

Probabilistic Risk Assessment (PRA) was tasked to continue with the editing of the Iteration 2 SRB PRA methodology, results and limitations for the Space Shuttle Program (SSP) this quarter.

PRA reviewed Rocketdyne's PRA on the SSME's nozzle wall tube failures and submitted comments. PRA's review was cursory and based solely on the information provided in Rocketdyne's PRA. PRA did however note that common causes of nozzle wall tube failure were not considered; Rocketdyne assumed that all tube failures would be independent. PRA recommended that the issue of common cause be raised in the Chief Engineer's telecon.

PRA developed presentation handouts for the External Tank PRA (Iteration 2) after having compiled a reference list of the SRB Basic Events and noted where they are documented in the SRB Shuttle PRA Iteration 2 Notebooks. A final draft version of this information was forwarded to JSC to be reviewed by their Tech Writer. PRA developed 11"x17" presentation handouts (Dr. Edward Tufte style) for the External Tank PRA (Iteration 2.) This overview, along with similar 11"x17" presentation handouts for each of the Shuttle elements, was developed at the request of JSC-MX's Shuttle Program Risk Manager.

PRA's integrated Iteration 2 Shuttle PRA models and extracted SRB and RSRM failure mode risk numbers were based on the previous 2000 QRAS PRA approach, for QD10 and ER30 in

support of their review of the proposed crew exploration vehicle. The RSRM's motor level analysis result was supplemented with component level relative contribution values from engineering judgment. Due to current PRA software limitation, the individual SRB failure mode risk results were extracted by hand so that the final listing of the SRB failure mode risks can be 'added' to get the overall SRB risk number. For the single basic events that lead directly to the LOCV top event (e.g. single point failure), they are listed directly from the fault tree cut sets. For AND-gate and redundancy gate logic, the risk model was quantified at the lowest level where the results can be 'OR-gated' or added to the top. This entailed the creation of the various offline models for quantify these AND-gate/redundancy gate including uncertainty. As a result additional changes were made to the 11x17 Iteration 2 SRB PRA methodology, results, and a limitations paper for the Shuttle Program.

With support from JSC Shuttle PRA team members, HEI PRA provided a briefing regarding the status of the Shuttle PRA and SSME PRA this period. The briefing included immediate deliverables and future work, to Pratt & Whitney Rocketdyne (PWR) at Canoga Park, CA, to the SSME Project Office and PWR. HEI PRA also discussed modeling shuttle in-flight abort and existing studies available to support the analysis with JSC Shuttle PRA team members, MSFC SMA and representatives from Rocketdyne.

PRA documented the findings of the STS-114 CCFA Eco Sensor Team in a (draft) NASA report delivered to QD40 this quarter. QD40 led the team which conducted a common cause failure analysis (CCFA) of the STS-114 ET ECO Sensor System before the decision was made to launch. The draft is complete with a final publication to be released.

Training

PRA was an active leader in training activities this quarter by working with System Safety on the presentation/notes regarding the Fault Tree Analysis class. The class was given to both HEI and NASA Civil Service employees.

PRA also traveled off-site to attend Reliasoft's Reliability Training on Weibull analysis, accelerated life testing, and reliability systems analysis in San Diego, CA this past reporting period.

4.7.3 Shuttle Reliability, Prediction & Risk Analysis

Risk Analysis (RAN) was presented with a Group Achievement Award this quarter by NASA for its consistent and dedicated assistance in returning the shuttle to it's safe flight status.

Risk Assessment (RAS) was tasked with analyzing ET TPS Infra Red (IR) data independently of the TPS Working Group. RAS found that the control panel on three of the panel types was from a different spray than the exposed panels. This made it impossible to tell whether an effect was due to sunlight or to differences due to spray. There were also other problems discovered with this test. The ET TPS Infra Red (IR) Working Group is looking at the effects of sunlight on TPS foam. Panels of several foam types were exposed to controlled IR, IR plus sunlight, or no radiation; several properties were examined on each panel.

Risk Assessment (RAS) took a very key part in telecons deciding which tests will be used for qualification in identifying foam flaws. NDE's ability to make such identification is an important topic, particularly in light of the foam lost from the Protuberance Aerodynamic Load (PAL) Ramp during the last flight. RAS insisted on a robust test which will show an equivalent of repeatability for backscatter and terahertz techniques, while it supported the use of natural flaws to determine POD for qualification. RAS's case was that if a measurement system is not repeatable, the POD number will be meaningless. A set of tests, including the repeatability test, were accepted by the team. In addition, RAS supported inclusion of a standardized filtering technique used in an Air Force application. This method will be tested as an augmentation to operator-decided image-filtering techniques.

Risk Analysis (RAN) was asked to evaluate whether a SSME nozzle tube leak detection method nondestructive evaluation (NDE) POD was necessary for a method proposed to be used to locate leaks in nozzle hydrogen tubes. The method could substantially reduce the use of the destructive technique used currently. Nozzle acceptance will still be done using a soap-bubble method. While RAN agreed with some that the users would benefit from a POD study, it helped form a consensus that since it will not be used for acceptance, a POD was not necessary. However, it supported QD20 in insisting that documents clearly state that the test must not be used for accepting nozzles without further testing.

A test plan was sent to Risk Analysis (RAN) for review this quarter on the techniques for gauging a SRB booster separation motor's (BSM) nondestructive evaluation (NDE) probability of detection (POD) of different flaw types in BSM carbon-fiber nozzles. The test looked at how well X-Ray can find voids and an alcohol wipe can find scratches; in addition, two new techniques, eddy current and ultrasonic, were also evaluated for scratches. RAN found the test plan basically sound, but there were a few fairly serious – though correctable – deficiencies. The most important deficiency is that the test matrices will not find and the data could be seriously compromised by, interactions between input factors, even though, in RAN's experience, interactions could be quite important. RAN suggests improving this test plan by using design of experiments (DOE) approaches.

Risk Analysis (RAN) has for many years kept a database that tracks launch delays, scrubs and aborts along with their causes. RAN revamped the database using newer Excel tools and has sent the completed report to its QD40 customer for their response on this report.

Risk Analysis (RAN) presented a short session during one of this quarter's Reliability Team meetings which outlined Measurement Systems Analysis (MSA), a method for analyzing whether a measurement process (instrument, operator, fixtures, etc.) is capable of making the intended measurement. This quality tool is used heavily in high-quality industries, and is being used more and more often at NASA. The objective was to familiarize the Reliability team with the tools and to recognize when the tool is recommended or required.

SSME ultrasonic fastener stretch measurement equipment is being updated by relating Erdman counts to load then to relating load to delta time. Risk Assessment (RAS) was asked to analyze the data for this testing. The main testing is being performed at Canoga Park and MSFC is performing a portion of the testing here to evaluate differences in location and to assure the

ESMD Generic Flow Process for Risk Management and met with NASA's Project Constellation Risk Management Officer to discuss risk management flow process, documentation, the organizational structure of Project Constellation and how it is impacted by the Exploration Systems Mission Directive (ESMD) re-organization.

CRM's support to QD20 continued through its review of the new shuttle risk management plan. CRM had initiated a review of the new plan to help define the shuttle risk process and how it will be applied throughout NASA. One key issue reviewed was the impact of hazard analysis as it affects the shuttle risk management process. The shuttle risk database, SIRMA, has the capability to link hazard reports with the risks that are affiliated with a hazard(s). Currently, the only documentation of this process is a SIRMA training presentation which needs to be translated into the shuttle risk management plan.

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The MSFC PMC has approved the CRM Team's proposal to conduct a Risk Management Maturity Assessment for the ISS Regenerative ECLSS. To-date, the CRM Team has reviewed

all risk related documentations provided by the MSRR-1 project. These data resources include: CRM Website Questionnaire; Data Collection/Worksheet; Project Risk Management Plan; Risk Reports; Detailed Risk Report; and, Project Schedules.

The MSFC PMC also approved the CRM Team's proposal to conduct a Risk Management Maturity Assessment for the Auxiliary Propulsion Project (APP). To-date, the CRM Team has initiated the Phase I RMMM Assessment for APP to include: CRM Website Questionnaire; Data Collection/Worksheet; Project Risk Management Plan; Risk Reports; Detailed Risk Report; and Project Schedules. The Phase II RMMM Assessment will include: Personal Interviews; Personal Observations; Develop RMMM Presentation to PM; and Present RMMM Presentation. CRM has developed and refined Observations and Findings to include Recommendations that will be presented to the APP Project Team during the out brief. CRM also conducted an interview with the APP Project Team during the week of 08/08/05 and developed its "Draft" APP Risk Management Maturity Assessment Out Brief Presentation based on all the data, observations and interviews conducted during the RMMM Assessment. The Out Brief has been finalized and presentation given to the APP Project Manager. This activity was completed September 2005.

The Phase II part of the MSFC RMMM Assessment is also complete. CRM has developed and refined Observations and Findings to include Recommendations that will be presented to the ECLSS Project Team during the ECLSS Risk Assessment Out Brief, the MSRR-1 Project Team during the MSRR-1 Risk Assessment Out Brief and the APP Risk Assessment Out Brief. The CRM Team met with the ECLSS Risk Manager 8/26/05 to observe a demonstration on ECLSS Risk Assessment Database (RAD). The purpose of this demonstration is to ascertain the type of risk statements, risk context and risk metrics generated with RAD. CRM developed a data structure handout for the ECLSS RAD administrator, N. Hill/NASA to enable her to refine the risk report structure and risk waterfall mitigation data in the RAD. In addition, CRM developed three "draft" presentations on: ECLSS Risk Management Maturity Assessment Out Brief, the MSRR-1 Risk Management Maturity Assessment Out Brief and the APP Risk Management Maturity Assessment Out Brief based on all the data, observations and interviews conducted during our RMMM Assessment along with the tentative final score base on RMMM data findings. These Out Briefs were pre-finalized, and then reviewed with QD40's IA Manager/NASA. Observations & findings scores were refined to present a clearer picture of the ECLSS Risk Management, MSRR-1 Risk Management and the APP Risk Management process. The RMMM Assessment Out Brief was presented to the ECLSS, MSRR-1 and APP Project Managers September 2005.

In an effort to establish a more proactive schedule for NASA & HEI professional certification, the CRM team worked with NASA & HEI management to establish a CRM training schedule as part of the professional certification process. This schedule of CRM classes will help personnel who are seeking certification help focus their training opportunities and will be posted to the Continuous Risk Management (CRM) website.

CRM was an active member of QD40's CAIB/Diaz Action Digital Close-Out Photography (DCOP) Assessment Team from MSFC this quarter. The objective of this team was to help establish digital close-out photography requirements throughout the agency once all reviews and results had been presented to NASA HQ. The team was organized in order to bench-mark the

many NASA/DoD contractor facility's (e.g. Lockheed-Martin in Sunnyvale, CA, Jet Propulsion Lab in Pasadena, CA, Boeing at KSC in FL and Raytheon in Andover, MA.). A final assessment report was completed and successfully presented 9/9/05 to NASA HQ in Washington, D.C. As a result of these efforts NASA HQ has requested that follow actions within the NPD 8730.x draft, include a "NASA Quality Assurance Program Policy". This policy will assure that all NASA programs, projects and Centers utilize DCOP consistently, and to the maximum extent possible.

The CRM Team was represented by HEI at the Risk Management Seminar sponsored by Program Management Institute (PMI). The course covered the following aspects of risk management: Uncertainty; Risks vs. Opportunity; Risk Breakdown Structure (RBS); and Managing Risk Attitudes. The seminar was comprised of members for a variety of industries to include automotive, banking, information technology (IT) and pharmaceutical. The seminar also addressed best practices for identifying project threats and opportunities as well as the PMI approach to risk management. This seminar was very informative and presented alternatives methods of presenting, analyzing and assessing project risks/opportunities. A recommendation is submitted to bring the seminar's moderator to MSFC to assess NASA's CRM process and develop the next stage in NASA CRM process.

The CRM Team was tasked to provide CRM Training in-house to MSFC employees and contractors this quarter. This 4-Hour CRM course re-familiarizes the student with the fundamentals of CRM. The areas of discussion focused on the following: (1) Risk Identification; (2) Analyzing Risks; (3) Plan; (4) Track; (5) Control; and, (6) Communicate and Document Risks; CRM facilitation and assessments. This special CRM training is an integral part of the Professional Development Training Plan (PDTP) requirement established as part of the for certification process for all HEI personnel.

4.7.2 Space Shuttle Probabilistic Risk Assessement (PRA)

Probabilistic Risk Assessment (PRA) was tasked to continue with the editing of the Iteration 2 SRB PRA methodology, results and limitations for the Space Shuttle Program (SSP) this quarter.

PRA reviewed Rocketdyne's PRA on the SSME's nozzle wall tube failures and submitted comments. PRA's review was cursory and based solely on the information provided in Rocketdyne's PRA. PRA did however note that common causes of nozzle wall tube failure were not considered; Rocketdyne assumed that all tube failures would be independent. PRA recommended that the issue of common cause be raised in the Chief Engineer's telecon.

PRA developed presentation handouts for the External Tank PRA (Iteration 2) after having compiled a reference list of the SRB Basic Events and noted where they are documented in the SRB Shuttle PRA Iteration 2 Notebooks. A final draft version of this information was forwarded to JSC to be reviewed by their Tech Writer. PRA developed 11"x17" presentation handouts (Dr. Edward Tufte style) for the External Tank PRA (Iteration 2.) This overview, along with similar 11"x17" presentation handouts for each of the Shuttle elements, was developed at the request of JSC-MX's Shuttle Program Risk Manager.

PRA's integrated Iteration 2 Shuttle PRA models and extracted SRB and RSRM failure mode risk numbers were based on the previous 2000 QRAS PRA approach, for QD10 and ER30 in

support of their review of the proposed crew exploration vehicle. The RSRM's motor level analysis result was supplemented with component level relative contribution values from engineering judgment. Due to current PRA software limitation, the individual SRB failure mode risk results were extracted by hand so that the final listing of the SRB failure mode risks can be 'added' to get the overall SRB risk number. For the single basic events that lead directly to the LOCV top event (e.g. single point failure), they are listed directly from the fault tree cut sets. For AND-gate and redundancy gate logic, the risk model was quantified at the lowest level where the results can be 'OR-gated' or added to the top. This entailed the creation of the various offline models for quantify these AND-gate/redundancy gate including uncertainty. As a result additional changes were made to the 11x17 Iteration 2 SRB PRA methodology, results, and a limitations paper for the Shuttle Program.

With support from JSC Shuttle PRA team members, HEI PRA provided a briefing regarding the status of the Shuttle PRA and SSME PRA this period. The briefing included immediate deliverables and future work, to Pratt & Whitney Rocketdyne (PWR) at Canoga Park, CA, to the SSME Project Office and PWR. HEI PRA also discussed modeling shuttle in-flight abort and existing studies available to support the analysis with JSC Shuttle PRA team members, MSFC SMA and representatives from Rocketdyne.

PRA documented the findings of the STS-114 CCFA Eco Sensor Team in a (draft) NASA report delivered to QD40 this quarter. QD40 led the team which conducted a common cause failure analysis (CCFA) of the STS-114 ET ECO Sensor System before the decision was made to launch. The draft is complete with a final publication to be released.

Training

PRA was an active leader in training activities this quarter by working with System Safety on the presentation/notes regarding the Fault Tree Analysis class. The class was given to both HEI and NASA Civil Service employees.

PRA also traveled off-site to attend Reliasoft's Reliability Training on Weibull analysis, accelerated life testing, and reliability systems analysis in San Diego, CA this past reporting period.

4.7.3 Shuttle Reliability, Prediction & Risk Analysis

Risk Analysis (RAN) was presented with a Group Achievement Award this quarter by NASA for its consistent and dedicated assistance in returning the shuttle to it's safe flight status.

Risk Assessment (RAS) was tasked with analyzing ET TPS Infra Red (IR) data independently of the TPS Working Group. RAS found that the control panel on three of the panel types was from a different spray than the exposed panels. This made it impossible to tell whether an effect was due to sunlight or to differences due to spray. There were also other problems discovered with this test. The ET TPS Infra Red (IR) Working Group is looking at the effects of sunlight on TPS foam. Panels of several foam types were exposed to controlled IR, IR plus sunlight, or no radiation; several properties were examined on each panel.

Risk Assessment (RAS) took a very key part in telecons deciding which tests will be used for qualification in identifying foam flaws. NDE's ability to make such identification is an important topic, particularly in light of the foam lost from the Protuberance Aerodynamic Load (PAL) Ramp during the last flight. RAS insisted on a robust test which will show an equivalent of repeatability for backscatter and terahertz techniques, while it supported the use of natural flaws to determine POD for qualification. RAS's case was that if a measurement system is not repeatable, the POD number will be meaningless. A set of tests, including the repeatability test, were accepted by the team. In addition, RAS supported inclusion of a standardized filtering technique used in an Air Force application. This method will be tested as an augmentation to operator-decided image-filtering techniques.

Risk Analysis (RAN) was asked to evaluate whether a SSME nozzle tube leak detection method nondestructive evaluation (NDE) POD was necessary for a method proposed to be used to locate leaks in nozzle hydrogen tubes. The method could substantially reduce the use of the destructive technique used currently. Nozzle acceptance will still be done using a soap-bubble method. While RAN agreed with some that the users would benefit from a POD study, it helped form a consensus that since it will not be used for acceptance, a POD was not necessary. However, it supported QD20 in insisting that documents clearly state that the test must not be used for accepting nozzles without further testing.

A test plan was sent to Risk Analysis (RAN) for review this quarter on the techniques for gauging a SRB booster separation motor's (BSM) nondestructive evaluation (NDE) probability of detection (POD) of different flaw types in BSM carbon-fiber nozzles. The test looked at how well X-Ray can find voids and an alcohol wipe can find scratches; in addition, two new techniques, eddy current and ultrasonic, were also evaluated for scratches. RAN found the test plan basically sound, but there were a few fairly serious – though correctable – deficiencies. The most important deficiency is that the test matrices will not find and the data could be seriously compromised by, interactions between input factors, even though, in RAN's experience, interactions could be quite important. RAN suggests improving this test plan by using design of experiments (DOE) approaches.

Risk Analysis (RAN) has for many years kept a database that tracks launch delays, scrubs and aborts along with their causes. RAN revamped the database using newer Excel tools and has sent the completed report to its QD40 customer for their response on this report.

Risk Analysis (RAN) presented a short session during one of this quarter's Reliability Team meetings which outlined Measurement Systems Analysis (MSA), a method for analyzing whether a measurement process (instrument, operator, fixtures, etc.) is capable of making the intended measurement. This quality tool is used heavily in high-quality industries, and is being used more and more often at NASA. The objective was to familiarize the Reliability team with the tools and to recognize when the tool is recommended or required.

SSME ultrasonic fastener stretch measurement equipment is being updated by relating Erdman counts to load then to relating load to delta time. Risk Assessment (RAS) was asked to analyze the data for this testing. The main testing is being performed at Canoga Park and MSFC is performing a portion of the testing here to evaluate differences in location and to assure the

accuracy of the readings at Canoga Park. RAS participated in discussions regarding verification testing and beginning part 2. Erdman and Norbar data was collected on Engine 0527 for seven joints. RAS continued analyzing the Engine 0527 data and prepared a presentation of the preliminary results for the team. The team also discussed the possibility of taking periodic readings of the machines to learn more about the variability of the measuring systems. RAS had previously mentioned the value of a stability study and has used this opportunity to prepare and present a synopsis of the study to the team. New fixtures for the testing were made and a preliminary plan was drawn up to test them. An addition was also made to the fixture testing plan by Boeing-Rocketdyne. RAS reviewed the change and found an experimental design would allow the team to maximize analytical results with less data points. RAS presented the experimental design to the team which decided to implement the design for the fixture and location testing. RAS continued to explain the merits of a designed experiment to the team. RAS also reviewed and provided recommendations for the laboratory test procedure and test plan for the fixture testing. Canoga Park recently developed a macro for data management for the fixture experiment and its future testing in order to aid in data analysis. RAS has begun its review of this macro and to offer suggestions for improvement. New fixtures for the testing have been made and verification testing has begun. The 1222, 0937 and 0506 bolt testing is now complete. RAS has analyzed the 1222 and 0937 data as well as analyzed the 0506 bolt. All results from these efforts have been presented to the team for review.

Risk Assessment (RAS) has completed two progress reports this period concerning the KSC PRACA database. These reports focus on just the RSRM problems at this time. Results so far: trends have been identified; data from 1996 to the present show a general decrease in the number of problems reported until 2001-2003 (roughly the time of the Columbia accident) but then an increase in reports is noticed; cause code descriptions are vague and deemed not useful at this point; problems with multiple names for the same part number have also been determined causing an inflation to the number of problems reported by KSC's database; miscellaneous findings have also been noted and are described in the progress reports; and future task is to compare KSC's PRACA database with MSFC's PRACA database.

Risk Assessment (RAS) evaluated the SSME turbo pumps and APU problems reported since 1988 this quarter. It was noticed that the biggest concentrations of cause codes were to be wear and tear related and most problems to be associated with the high pressure fuel turbo pumps (HPFTP). RAS located information on the correction of each problem noted and prepared a progress report.

Risk Assessment (RAS) presented its paper entitled "Measurements on the Space Shuttle Booster Separation Motors" at the NCSLI (National Conference of Standards Laboratories International) 2005 symposium held 8/8-11/05 in Washington, D.C. This organization and symposium serves the world of metrology and is probably the premier gathering of professionals involved in metrology. The paper describes portions of work done by RAS (and others) while a member of the tiger team investigating the BSM measurements and results. The focus of this paper was on the evolution of capacitance measurements from theoretical beginnings to the final imperial prediction equations. Error analysis and propagation of error results were also described.

4.7.4 Advanced Projects Risk Assessment (RAS)

Risk Assessment continued its support to Advanced Projects (QD10) by completing documentation on the analyses performed during the 60 day engine study, including reliability growth, and Space Shuttle Main Engine (SSME) failure mode allocation used for similarity analysis. RAS also detailed the failure modes on the Reusable Solid Rocket Motor (RSRM) and the Solid Rocket Booster (SRB) to determine failure mode applicability on the new crewed vehicle configuration. The data was given to the project offices to get their expert opinion on the applicability of the failure modes. RAS awaits feedback on the data given to the project offices in order to get their expert opinion on the applicability of the failure modes.

RAS, using QRAS 2000 models, performed a PRA on the RSRM based on the expert opinion of the RSRM project office. RA took the applicable failure modes for the new crewed vehicle from the project office and calculated the new RSRM risk. RAS also analyzed the event sequence diagrams and failure probabilities from QRAS to determine risk allocation for these elements. RAS modeled all the applicable failure modes of the Reusable Solid Rocket Motor (RSRM), and performed a Monte Carlo analysis to determine the probability of failure of the RSRM applied to the new exploration crew vehicle. The data for the RSRM was taken from the Quantitative Risk Assessment System (QRAS) 2000 Probabilistic Risk Assessment (PRA).

RAS provided a presentation on the status of the Constellation Probabilistic Risk Assessment (PRA) Methodology Document for this quarter's face to face meeting at JSC. At this point there are no major issues with the PRA Methodology Document.

RAS also continued working on STARS this quarter by adding a database section to the motor builder, and putting place holders for future failure mode calculation from Event Sequence Diagrams (ESDs).

RAS, using QRAS 2000 models of the SRB determined failure mode applicability on the new crewed vehicle configuration for Exploration Systems. The data was given to the project office to get their expert opinion on the applicability of the failure modes. The applicable failure modes are currently being modeled, and a Probabilistic Risk Assessment (PRA) will be performed on these models.

5.0 Cost Reduction Items

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicial acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.